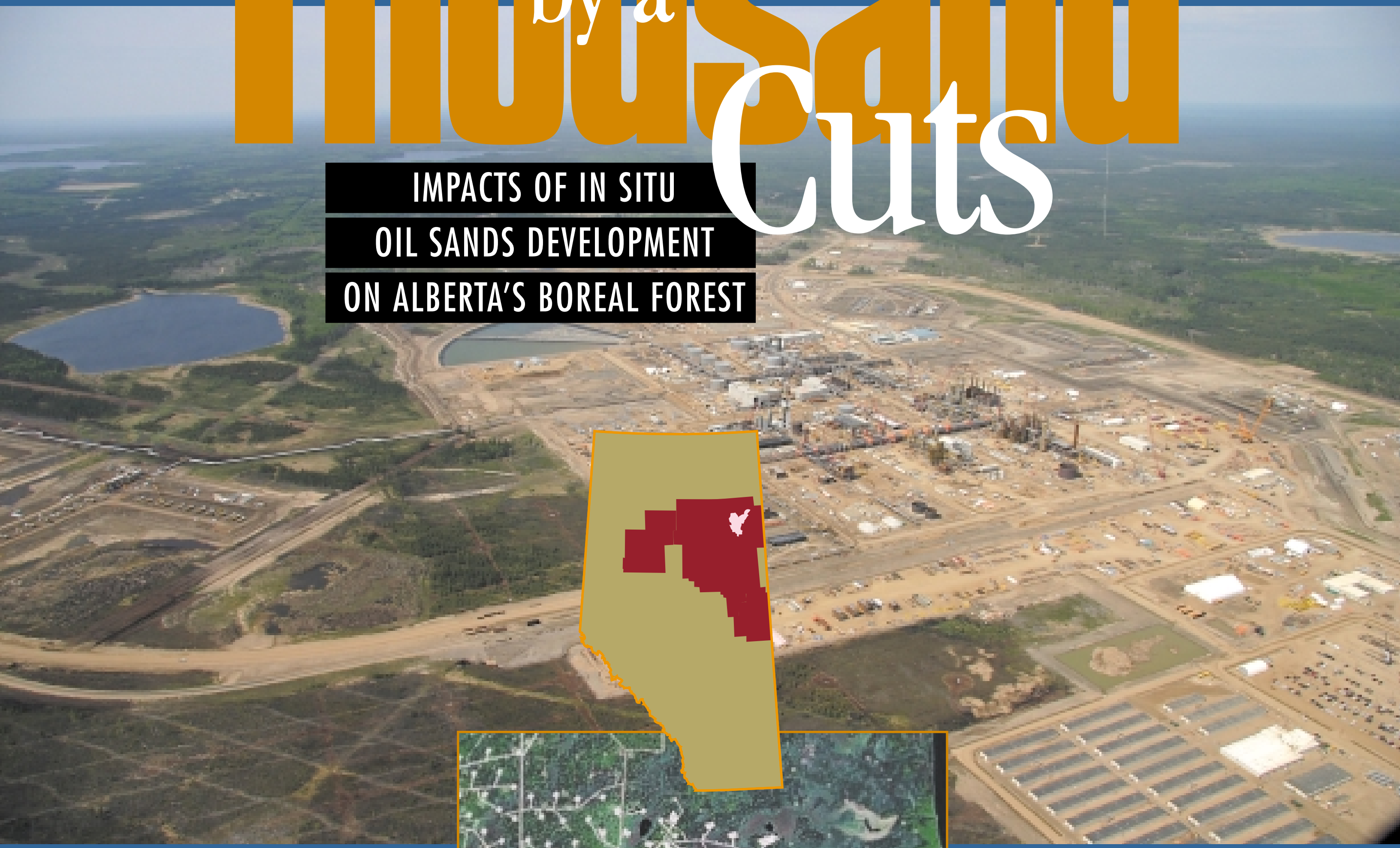
Death by a Thousand Cuts

IMPACTS OF IN SITU OIL SANDS DEVELOPMENT ON ALBERTA'S BOREAL FOREST



RICHARD SCHNEIDER • SIMON DYER

August 2006

Oil SANDS Fever SERIES

CPAWS
CANADIAN PARKS AND WILDERNESS SOCIETY

the PEMBINA institute

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The Pembina Institute
Box 7558
Drayton Valley, Alberta T7A 1S7

Phone: 780.542.6272
E-mail: piad@pembina.org

CPAWS Edmonton
P.O. Box 52031
Edmonton, Alberta, T6G 2T5

Phone: 780.432.0967
E-mail: info@cpaws-edmonton.org

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vi About the Authors

Richard Schneider

Dr. Richard Schneider has been with CPAWS Edmonton since 1993 and currently serves as Conservation Director for the chapter, primarily overseeing the chapter's boreal program. Richard obtained a degree in veterinary medicine from the University of Saskatchewan in 1985 and a Ph.D. in wildlife epidemiology from the University of Guelph. He then completed an NSERC postdoctoral fellowship at the University of Alberta, studying the relationship between wolves, bison, and disease in northern Canada. Richard has been actively involved in several landscape-level forest management initiatives in Alberta and wrote the book Alternative Futures: Alberta's Boreal Forest at the Crossroads as well as numerous influential papers on the management of Alberta's forests.

Simon Dyer

Simon Dyer is a Senior Policy Analyst with the Pembina Institute. Simon is a member of Pembina's Energy Watch team, where his research focuses on the environmental implications of oil sands development. Simon is a biologist by training and has worked on land use issues in Alberta's boreal forest since 1999. Simon represents the Pembina Institute on the Sustainable Ecosystems Working Group of the Cumulative Environmental Management Association (CEMA). Simon holds a Master of Science in Environmental Biology and Ecology from the University of Alberta, and a Master of Arts in Natural Sciences from the University of Cambridge.

PHOTOS: DAVID DODGE, THE PEMBINA INSTITUTE

vii Executive Summary

▲ *This report examines the land impacts of in situ development of deep oil sands that has the potential to occur over a region 50 times larger than the oil sands mining area north of Fort McMurray.* PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

Currently, most Alberta oil sands production takes place in open pit mines. It is these shovel and truck operations that most people have come to associate with oil sands development. However, only a small fraction of the available oil sands deposits in Alberta are close enough to the surface to be mined. The bulk of the established reserves (81%) are deep below the surface and must be extracted using in situ (in-place) techniques. Although in situ recovery is less destructive than open pit mining, it is significantly more damaging than conventional oil extraction methods. Moreover, if in situ recovery of all of Alberta's underground reserves is allowed to proceed, the area impacted will be vast – approximately 13.8 million hectares (ha), or 50 times the area of the mining zone. This equals 21% of Alberta, or a land area the size of Florida.

Executive Summary *(CONTINUED)*

The primary in situ extraction technique is called Steam Assisted Gravity Drainage (SAGD). It involves the use of high-pressure steam to liquify the tar-like oil sands deposits so that they can be piped to the surface.

In this report, the 10,600 ha OPTI-Nexen Long Lake project, now under development, is used as a case study of a state-of-the-art SAGD operation. A total of 8.3% of the Long Lake lease will be cleared for SAGD infrastructure, including a 99 ha central facility, 234 exploration wells, 288 production wells, 89 km of access roads, and an extensive aboveground pipeline collection system. Once construction is completed, approximately 80% of the 10,600 ha land parcel will be within 250 m of an industrial feature. Approximately 24,000 m^3 of water will be needed each day for steam production and processing; although 90% will be recycled, the remainder will be lost through disposal in deep wells. The anticipated lifespan of the project is 40 years.

As of July 2005, the total area of land leased for in situ development in Alberta was 3.6 million ha. If all these leases, most of which have yet to be developed, are subjected to the same industrial footprint as the Long Lake project, then 296,000 ha of forest will be cleared for SAGD infrastructure and over 30,000 km of access roads will be built. This is a conservative estimate and does not take into account transient disturbances such as seismic exploration, forest harvesting, or wildfire. Furthermore, new leases are continually being awarded by Alberta's Department of Energy. The implications are startling. By even the most conservative estimate, there will be more long-term deforestation from SAGD development than if the entire mineable oilsands region is completely cleared. The ecological effects will be many times greater still, because the SAGD disturbances will be dispersed across a vast region.

The boreal forest in which the SAGD developments are taking place is home to many wildlife species known to be sensitive to industrial disturbances. For these species, useable habitat within a SAGD development area is reduced to small scattered islands. Once a threshold is reached where the remnant habitat patches are too small and scattered to maintain a breeding population, the local population is extinguished. Multiply this effect by all projected SAGD developments and the result is a serious decline in regional biodiversity.

Although precisely defined ecological thresholds have not been defined, evidence is steadily mounting that ecological tipping points for many species are already being exceeded at current levels of industrial development

Executive Summary *(CONTINUED)*

in northern Alberta. The impacts of SAGD development, which are much more intense and prolonged than those resulting from conventional forms of petroleum development, will be additive to existing impacts of current and past oil extraction. Therefore, ecological thresholds will be greatly exceeded in the future under planned development trajectories. In this report we present evidence from studies of three wildlife groups – caribou, furbearers (e.g., lynx, marten) and forest birds – within which some species are at risk of extirpation from oil sands development.

Given the severe and unavoidable impacts anticipated from widespread SAGD development, extra effort needs to be placed on finding alternatives to in situ extraction. Regardless of the approach used, the overall infrastructure footprint and related impacts of in situ developments must be significantly reduced. Several examples of industrial best practices are reviewed in this report, including reduced impact seismic exploration, integrated operational planning, reduced impact well pad construction, and footprint restoration.

Although mitigation and reclamation efforts will be beneficial, it is becoming increasingly apparent that, even with state-of-the-art practices, the cumulative ecological impacts of in situ development will be devastating. Therefore, conservation offset measures, such as the establishment of wildlife reserves where industrial development is not permitted, need to be implemented. In addition, a cap must be placed on cumulative industrial impacts so that basic ecological function is maintained on the industrial land base. Examples from elsewhere in Canada, such as the Muskwa-Kechika management plan in northern British Columbia and the draft Dehcho management plan in the North West Territories, demonstrate how regional planning, protected areas, and limits on cumulative impacts can be incorporated into management planning.

If there is to be any hope of balancing ecological and economic objectives in the oil sands region then new approaches to land management, supported by appropriate policy and planning frameworks, will need to be implemented. There is an urgent need for the development of a regional strategic plan that includes long-term management objectives and a process for achieving these objectives. The anticipated impacts associated with unconstrained in situ oil sands development are so great that no futher oil sands leases should be awarded or projects approved until a management plan is in place to protect the regional environment.

x Summary of Recommendations

1. Alberta Sustainable Resource Development should develop a regional plan to protect the boreal forest of northeastern Alberta with the following elements:

- A clear expression of public values, expressed as long-term management objectives for the region;
- Land use designations and quantitative management targets that direct the timing, location, and intensity of development at the regional scale, to be implemented through the tenure allocation process and regulatory mechanisms; and
- The establishment of a comprehensive environmental baseline characterizing northeastern Alberta prior to industrial development (i.e., circa 1950), to serve as the reference against which the impacts of future developments are compared.

2. Alberta Energy should suspend new tenure allocations and Alberta Environment should suspend new project approvals until the regional plan is in place.

3. Alberta Sustainable Resource Development should establish new interconnected protected areas representative of the boreal region, as a conservation offset measure.

4. Alberta Sustainable Resource Development should establish quantitative limits on cumulative industrial disturbances and precautionary standards for wildlife habitat to ensure that ecological thresholds are not exceeded and environmental values are protected.

5. Alberta Sustainable Resource Development should establish a Land Management Planning Standard, modeled on the Forest Management Planning Standard, to guide the development of operating plans for all resource companies working in a given management area. The standard would compel companies to work together to devise workable integrated solutions for achieving shared landscape-scale land management objectives. A single government agency dedicated to integrated land management should be established to provide oversight and facilitation of this process. A key role for the government is to ensure that the solutions companies devise are equitable, and consistent with regional land management and conservation objectives.

6. All government departments should establish minimum standards, reflecting industrial "best practices," that companies must employ to minimize damage to the boreal forest:

- Implement alternatives to SAGD that are less environmentally destructive (less water, less energy, less land disturbance, less duration) as rapidly as possible;
- Conduct seismic programs in such a way that the lines are visibly

Summary of Recommendations

reintegrated into the forest within five years. This can be achieved by cutting narrow lines (< 2.5 m), leaving soil and root systems intact, and including barriers to motorized access;

- Integrate planning with forestry companies operating on the same land base, including harmonized road construction;
- Limit cumulative linear disturbances by reusing or reforesting existing disturbances before additional disturbances are added to the system; and
- Incorporate monitoring programs like the Alberta Biodiversity Monitoring Program into operations and track and report on the cumulative industrial disturbance related to projects.

▲ *The boreal forest of northern Alberta will be dramatically affected if plans to exploit oil sands on 138,000 km² are carried out.* SOURCE: DAVID DODGE, THE PEMBINA INSTITUTE

▲ *The OPTI-Nexen Long Lake project includes an upgrader to convert bitumen into synthetic crude oil.*

SOURCE: DAVID DODGE, PEMBINA INSTITUTE

Introduction

Canada's boreal region contains one-quarter of the world's remaining original forests. It is home to a rich array of wildlife including migratory songbirds, waterfowl, bears, wolves and the world's largest caribou herds. Canada's boreal is a major part of the global boreal region that encircles the Earth's northern hemisphere, storing more freshwater in its wetlands and lakes and more carbon in its trees, soil, and peat than anywhere else on the planet. The Canadian boreal forest is also the location of one of the world's largest deposits of oil – Alberta's oil sands.

With conventional oil reserves in North America in steady decline, Alberta's oil sands have begun to attract significant attention, both locally and internationally. Currently, the majority of oil sands production comes from open pit mining facilities, and it is these shovel and truck operations that most people have come to associate with oil sands development. The mining zone currently extends across approximately 3,300 km^2 of northern Alberta[1] and, when fully developed, will likely qualify as the world's largest open pit mining complex.

What is not well known is that only a fraction of the total available oil sands deposits are close enough to the surface to be mined. The bulk of the established reserves (81%) must be extracted using in situ (in place) techniques.[2] Although in situ recovery

FIGURE 1: Map of Alberta's oilsands

SOURCE: RICK SCHNEIDER, CANADIAN PARKS AND WILDERNESS SOCIETY

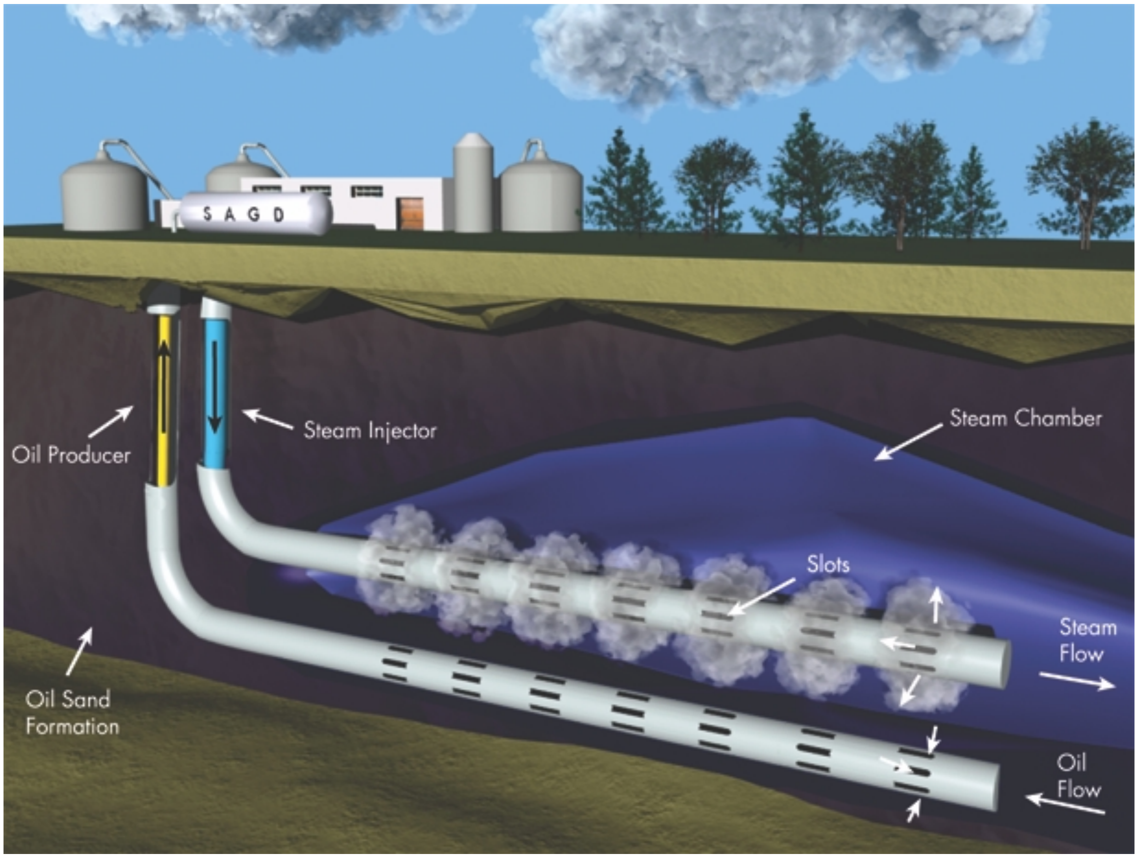
Introduction

is less destructive than mining, it is significantly more damaging than the conventional oil operations to which it is often compared. Moreover, if all available deposits are to be extracted, the potential area impacted will be vast – approximately 138,000 km^2 (13.8 million hectares), which is 50 times larger than the area of the mining zone.[3] This is equivalent to 21% of Alberta, or a land area the size of Florida (Fig. 1).

In this report we focus on Steam Assisted Gravity Drainage (SAGD), the primary technique for in situ oil sands recovery. We provide a description of the process through a case study of the OPTI-Nexen Long Lake project, now under development near Fort McMurray. The intent is to provide a detailed description of a SAGD project at ground level, using a real-world example that incorporates a number of new features designed to minimize environmental impacts. We then provide projections of anticipated regional environmental impacts by extrapolating the ecological footprint of individual projects, such as the Long Lake project, to the entire oil sands region. As with many oil sector activities, it is the regional cumulative impact of multiple developments, not the impact at any specific site, that is of greatest concern. Finally, we discuss practices and planning options for maintaining the ecological health of the oil sands region.

1 Case Study: The OPTI-Nexen Long Lake Project

1.1 Overview



▲ *FIGURE 2: Schematic of a SAGD production system.* SOURCE: J&W COMMUNICATIONS, THE PEMBINA INSTITUTE

The type of oil found in oil sands deposits, termed bitumen, is heavy, viscous and not easily extracted. In the SAGD process, two horizontal wells separated by a small vertical distance are placed near the bottom of the oil formation (Fig. 2). The top horizontal well is used to inject high-pressure steam, which rises to form a high-temperature steam chamber above the well. Within the steam chamber the heated bitumen becomes less viscous and flows by gravity to the lower well where it is collected, along with the condensed water.

OPTI Canada and Nexen Inc. are joint-venture partners developing the $3.5 billion Long Lake SAGD project located on a 10,600 ha site 40 km southeast of Fort McMurray (Fig. 3).[4] Approval for the project was granted in 2003 and production is slated to begin in late 2006. The SAGD operation will be coupled with an on-site upgrader and cogeneration facilities and is anticipated to produce 60,000 barrels of synthetic crude oil per day. Over the 40-year life of the project, approximately 288 well pairs will be drilled from up to 48 well pads.[5] It is expected that at least 50% of the original bitumen in place within the project area will be recovered.[6]

FIGURE 3: Map of Long Lake SAGD project.
SOURCE: OPTI/NEXEN, EIA

1.2 Exploration

Outside of the surface mineable region the geological layer comprising the oil sands is generally less than 30 m thick.[7] Therefore, successful implementation of the SAGD process demands precise placement of the horizontal wells. This in turn requires detailed information about the location and extent of the deposits, gathered through extensive exploration activities.

The initial phase of exploration is focused on assessing the commercial viability of the deposit and delimiting its extent. This is accomplished by drilling a systematic grid of core holes and conducting two-dimensional (2D)

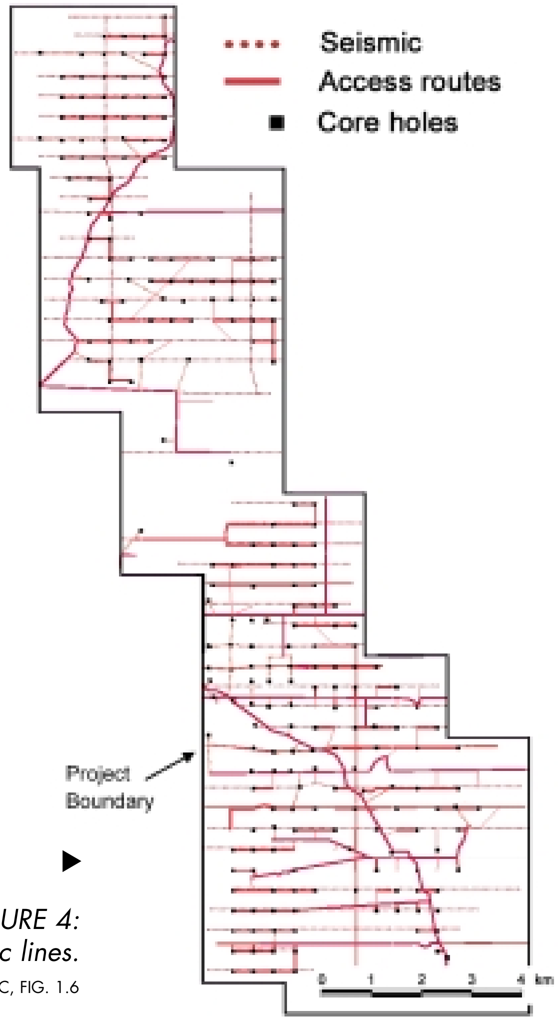


FIGURE 4: Map of core holes and 2 dimensional seismic lines.
SOURCE: OPTI APPLICATION, SECTION C, FIG. 1.6

▲ *FIGURE 5: Satellite photo of core holes and access roads on Long Lake site.*

SOURCE: GOOGLE EARTH © 2005 GOOGLE, IMAGE © 2006 DIGITAL GLOBE

seismic exploration (Fig. 4). As the name suggests, core holes are used to retrieve core samples of the subsurface geology. These core holes are generally drilled using conventional drilling practices that include developing access routes for heavy machinery and clearing between 0.5 and 1 hectare of forest (Fig. 5). A total of 234 core holes are planned for the Long Lake site.[8]

Seismic exploration involves the production and analysis of underground sound waves to generate a computer model of subsurface geological structures. In forested areas a corridor is usually first cleared for access and then truck-mounted drilling equipment is used to drill a series of shot holes at defined locations. Dynamite charges are placed in the shot holes and then detonated to generate seismic sound waves. As the dynamite charges are sequentially exploded the reflected sound waves are recorded at the surface using portable recording equipment. Until a few years ago, seismic lines were typically 6-8 m in width.[9] The average width in the Long Lake project will be 4 m.[10]

Conventional 2D seismic is sufficient for coarse delineation of deposits, but not for the accurate placement of horizontal wells. Therefore, prior to production additional seismic exploration is conducted to produce detailed 3D models of the deposit. To produce these detailed models intensive 3D seismic techniques must be employed where lines are laid out in a tight cross-hatch pattern (Fig. 6). In some cases seismic programs are repeated, in so-called 4D seismic, to monitor changes in the deposit over time.[11]

▲ *FIGURE 6: Aerial photo of 3D seismic on Long Lake site, with 60 m line spacing.* SOURCE: DAVID DODGE, THE PEMBINA INSTITUTE

After exploration activities have been completed the core holes and seismic lines are reclaimed. On the Long Lake site initial reclamation efforts have included backfilling of holes, scarification of well pads, and redistribution of debris piles across the area.[12] A grass seed mixture including fowl bluegrass, sheep fescue, Canada wildrye, awned wheatgrass and tufted hairgrass is being planted to minimize erosion. Other efforts have included the decommissioning and reclamation of access roads.

1.3 Production

The Long Lake project is designed to produce 9,600 m^3/day (approximately 60,000 barrels/day) of bitumen over a period of 35-40 years.[13] Because individual well pads only have a projected life of up to 12 years before local reserves are exhausted, new pads will continually be added as older wells cease production. It is anticipated that 48 well pads will be required in total. Plans call for the reclamation of individual well pads immediately after they cease operating. The reclamation of such long-term disturbed areas will include the replacement of stockpiled reclamation material followed by the replanting of appropriate tree and shrub species.[14]

Well pads will be 3.8 ha in peatlands and 4.4 ha in uplands (the larger size in upland sites is needed to accommodate soil storage).[15] Each well pad will host five paired wells (Fig. 7). Approximately 500 m^3 of drilling waste will be generated from the drilling of each well pair.[16] This drilling waste will be disposed of using the mix, bury and cover method,[17] or shipped to a landfill following government guidelines. Well pads will be bermed to contain accidental spills.

FIGURE 7: Horizontal well. SOURCE: PETRO-CANADA ▼

There will be an above ground interconnecting pipeline system between the well pads and the central facility including a steam supply line, produced bitumen/water line, and a produced gas and steam line (Fig. 8). There will also be overhead power lines to each pad, an underground pipeline for lift gas (see below), and an all-weather service road. The proposed access routes will follow existing cleared rights-of-way wherever possible; however, about 70% of all roads and corridors will require new clearing.[18] A total of 31 road and pipeline crossings of watercourses are proposed for the project.[19]

The project design includes the use of artificial gas lift to aid production.[20] Up to 5 m^3 of natural gas per m^3 of produced fluids will be injected into the bottom of the production well. The addition of the gas reduces the density of the column of water-bitumen sufficiently to allow it to flow to the surface. Lift gas will be returned to the central facilities with the produced fluids, treated, and then utilized as fuel in the project facilities. Lift gas for the project will be supplied through a new 10.2 km pipeline linked to the TransCanada pipeline system.

FIGURE 8: Pipeline gathering system.
SOURCE: PETRO-CANADA

Steam for the project will be produced in the central facility (described below). Approximately 24,000 m^3/d of water will be needed to recover the projected 9,600 m^3/d of oil (a 2.5:1 ratio).[21] Most of the process water will be recycled, but about 10% will be disposed of through deep well injection into a formation of water-bearing sand below the bitumen resource. This disposal is necessary to avoid accumulating too high a mineral content in the water for steam generation. The disposal wells will be connected to the central plant by an 8.7 km underground pipeline. Make-up water will be drawn from new wells located on the lease.[22] A 24.8 km underground pipeline will connect the water wells to the central plant.

1.4 Processing

The Long Lake project will include a large (98 ha) central processing facility where steam for the wells will be produced and where processing of bitumen will occur (Figs. 9-10). Plans call for the construction of a cogeneration plant that will produce both steam and electricity. The cogeneration plan will produce 400 MW of electricity, of which approximately 40 MW will be used by project facilities and the balance sold into the wholesale Alberta grid.[23]

The market for crude bitumen is very limited, so normally it is diluted and transported by pipeline to refineries for upgrading to synthetic crude. Dilution with lighter petroleum products is necessary to reduce the viscosity of the bitumen enough that it will flow in a pipeline. The Long Lake project will initially follow this approach, bringing diluent in via a 5.8 km Enbridge pipeline.[24] However, the central processing facility will eventually include an upgrader that will produce synthetic crude oil on-site (Fig. 11).

The central facility will also include a gasification facility that will use by-products of the upgrading process to produce sweet synthetic gas for use in project facilities. By-products of the gasification process include a non-hazardous slag, formed from minerals and metals in the feed, and sulphur.[25]

Subsequent to the construction of the gasification facilities, approximately 50% of the project's fuel requirements, including operation of the cogeneration plant, will be provided by synthetic gas. Natural gas from the TransCanada pipeline will provide the balance of the fuel requirements. Excluding the cogeneration plant, only about 11% of the project's fuel requirements will come from off-site natural gas.[26]

All SAGD produced gas will be recovered, collected and combined with upgrader produced gas for treatment. Treatment involves amine sweetening followed by glycol dehydration to generate dry sweet fuel gas.[27] This gas will be used in project heaters and steam generators to reduce natural gas requirements. Hydrogen sulphide will be removed from the gas and will be recovered and sold. No SAGD gas will be flared under normal operation.[28]

FIGURE 9: Long Lake ground view.
SOURCE: NEXEN

FIGURE 10: Land clearing associated with the OPTI-Nexen central processing facility.
SOURCE: GOOGLE EARTH © 2005 GOOGLE, IMAGE © 2006 DIGITAL GLOBE

FIGURE 11: Hydrocracker component of the Long Lake upgrading facility
SOURCE: NEXEN

2 Regional Environmental Impacts

2.1 Cumulative Impacts

▲ *The central facility of the OPTI-Nexen Long Lake SAGD project.*

SOURCE: DAVID DODGE, THE PEMBINA INSTITUTE

The Energy and Utilities Board estimates that 142 billion barrels of bitumen can be recovered using current in situ technology.[29] The total volume of bitumen in place is over ten times this amount; therefore, it is anticipated that established reserves will grow even larger as technology advances.[30] Moreover, only 1.0% of the 142 billion barrels of established reserves have been recovered to date. This means that projects like Long Lake are just the tip of the oil sands iceberg.

There is no terrestrial cumulative impacts framework to guide oil sands development. Instead, the process is driven by geology and the price of oil. When the price of oil is high, the Department of Energy issues more leases through its land sales process, with no consideration of the possibility of staged development or the preservation of regions with high conservation value. While individual projects do undergo environmental impact assessments (EIAs), projects are permitted to proceed if they meet standard industry practices, and no projects have been substantially modified to reflect conservation concerns.

To gain a realistic appreciation of the scope and magnitude of future in situ development we projected the disturbance footprint that will result from the development of oil sands leases that have already been awarded.

BOX 1. SUMMARY OF PROJECT INFRASTRUCTURE[34]

Main access road (7.9 km)
Other access roads (81 km)
Seismic lines (total km unknown)
Core holes (164 ha)
Well pads and infrastructure (457 ha)
Gas supply line (10.2 km)
Oil pipeline (5.8 km)
Power line (5.8 km)
Water supply and disposal wells (31 ha)
Central facility (99 ha)

Total = 884 ha of disturbance

BOX 2. SUMMARY OF CENTRAL FACILITY COMPONENTS

Fired steam generators
Bitumen/water separation vessels
Bitumen upgrading facilities
Power and steam cogeneration
Water recycling and treatment facilities
Gasification facilities
Desulphurization facilities
Utility systems; office
Produced and by-product gas handling
Diluent and product storage
Spent lime disposal
Reclamation material storage

The actual long-term impact will be significantly greater than our projections because new leases continue to be granted, now at a record pace. Even when underestimated, the initial results demonstrate that the boreal forest will be subjected to unprecedented levels of disturbance.

As the basis for our projections we used Long Lake as a template of a state-of-the-art SAGD project, primarily because extensive data and satellite photography were available. We quantified the various disturbances associated with the Long Lake project as described in the project's EIA and then assumed that other existing leases would be subjected to similar types and amounts of disturbance.

The Long Lake Project lease area is approximately 10,600 ha in size.[31] According to the EIA, the well pads, roads, pipelines, central facility, initial seismic exploration, and other miscellaneous features will result in the long-term clearing of 884 ha of land, representing 8.3% of the project site (Boxes 1 and 2).[32] Of the total disturbance, 96% (846 ha) will occur in previously undisturbed forests and peatlands. A review of the EIAs of other SAGD projects indicates that this level of disturbance is typical of such developments.[33]

Although 884 ha, or 8.3% of the project site, may not seem like an excessive amount of disturbance, there are two characteristics of the disturbances that are cause for significant concern: First, with the exception of the central facility, the disturbances are widely distributed across the project area. Based on the EIA

BOX 3. SUMMARY OF PROJECTED IN SITU DISTURBANCES

(see text for explanation)

Land clearing per lease	*8.3%*
Density of roads, pipelines, and power lines within leases	*3.2 km/km²*
Total in-situ lease area (2005)	*3,568,000 ha*
Total projected area cleared	*296,000 ha*
Total projected roads	*30,000 km*

data,[35] on the Long Lake site the density of roads, pipelines, and power lines (seismic excluded) will be 3.2 km/km^2. Considering that the ecological effect of each disturbance extends out into the surrounding forest, the majority of the forest will be impacted (see Environmental Effects, next page).

The other concerning characteristic of this type of disturbance is its duration. Not only are the disturbances at high density and widely distributed, but most will persist on the landscape for decades. This is in stark contrast to natural disturbances, such as fire, which are generally intense but have only a transient impact because regeneration occurs quickly.

The extensive 3D seismic exploration visible on recent aerial photos of the Long Lake site (Fig. 6) was not included in the Long Lake EIA data. Pre-existing disturbances in the lease area (e.g., roads, earlier seismic activity) were not included in the 884 ha total either, unless they were reused in the project. We could not incorporate these additional disturbances into our base-case footprint because they have not been quantified. Therefore, our projections underestimate the actual likely impact.

As of July 2005, the total area leased for in situ development was 3,568,000 ha, approximately 11 times the size of the mineable oilsands region.[36]
If all the leases are subjected to a similar industrial footprint to the Long Lake project then 296,000 ha of forest will be cleared for SAGD infrastructure and over 30,000 km of access roads will be built (Box 3). This is a conservative estimate and does not take into account transient disturbances such as seismic

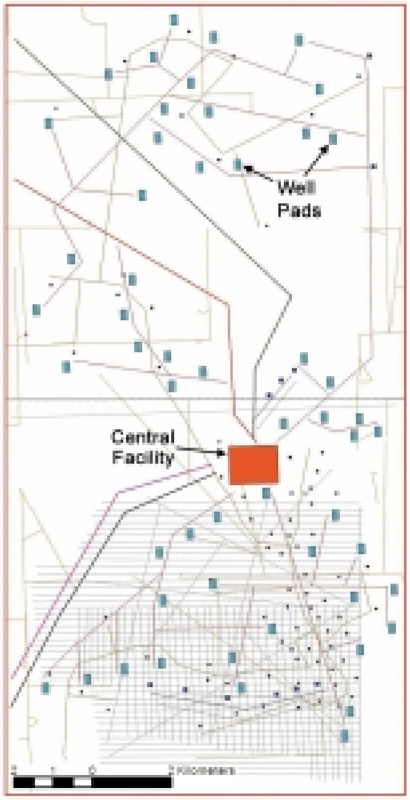
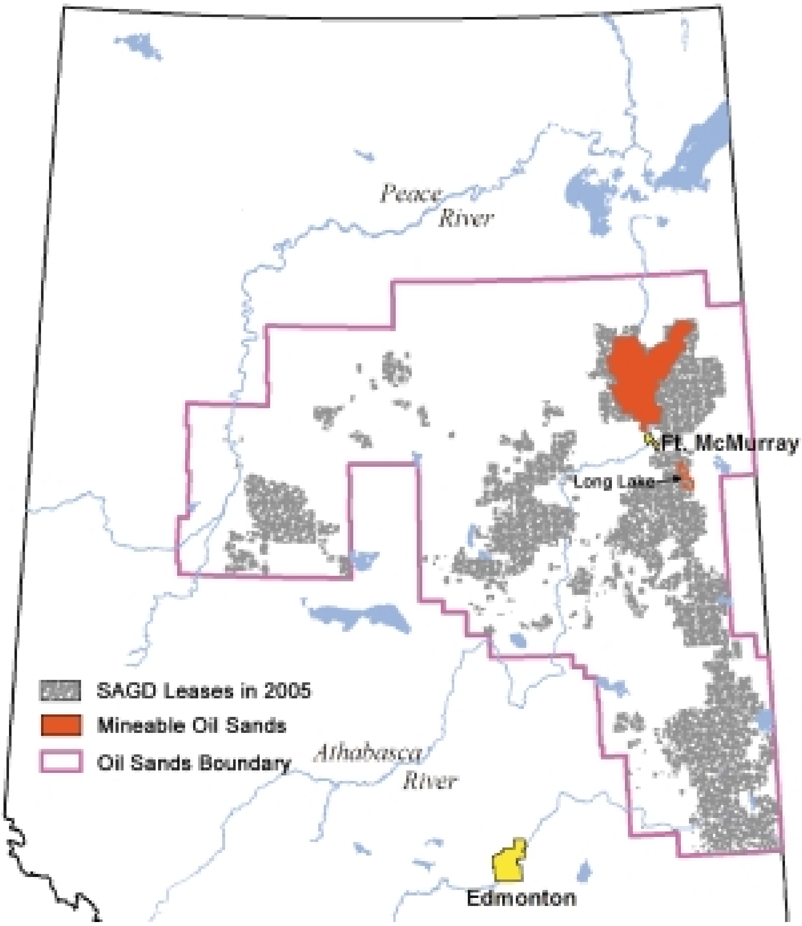


FIGURE 12: SAGD disturbance template modeled on the Long Lake project.
SOURCE: THE PEMBINA INSTITUTE

FIGURE 13: Projected SAGD disturbance footprint at medium scale (approximately 20% of the in situ region is shown). The location of the Long Lake project is outlined in red for reference.
SOURCE: CANADIAN PARKS AND WILDERNESS SOCIETY



▲ *FIGURE 14: Projected SAGD disturbance footprint across northern Alberta based on existing leases. The location of the Long Lake project is shown in red for reference, as is the oil sands administrative boundary*

SOURCE: CANADIAN PARKS AND WILDERNESS SOCIETY

exploration, forest harvesting, or wildfire. Furthermore, new leases are continually being awarded.

By even the most conservative estimate, there will be more long-term deforestation from SAGD development than if the entire mineable oilsands region were to be completely cleared. The ecological effects will be many times greater still, because the SAGD disturbances will be dispersed across a vast region. To fully appreciate the intensity and spatial scope of the projected impacts it is helpful to see them in map form. Therefore, we developed a template of an industrial footprint modeled on the Long Lake project (Fig. 12) and then projected this template in random orientation across all existing oil sands leases (Figs. 13-14). Given the long lifespan of the projects, the extended lag time associated with successful reforestation, and the fact that new leases continue to be awarded, the projected footprint is a very conservative estimate of what Alberta's boreal forest may look like in the future as a result of unconstrained in situ development.

2.2 Environmental Effects

Future SAGD developments will have environmental impacts on land, water and air, as well as contribute to climate change. In this report we focus on terrestrial ecosystems, where the most significant change will be a regional decline in biodiversity. This is because the boreal forest in which these developments are taking place is home to many wildlife species known to be sensitive to industrial disturbances (Box 4).

Recent studies in Alberta have shown that forests adjacent to roads, well sites and pipelines are avoided by a variety of forest mammals and birds due to their sensitivity to human disturbances.[37] For these animals, useable habitat within a SAGD development area is reduced to small scattered islands. Within the Long Lake project approximately 80% of the land will be within 250 m of an industrial feature (Fig. 15). The direct loss and avoidance of habitat results in declining wildlife populations. Further declines occur once a threshold is reached where the landscape as a whole becomes unsuitable (i.e., once the remnant habitat patches are too small and scattered to maintain a breeding population).[38]

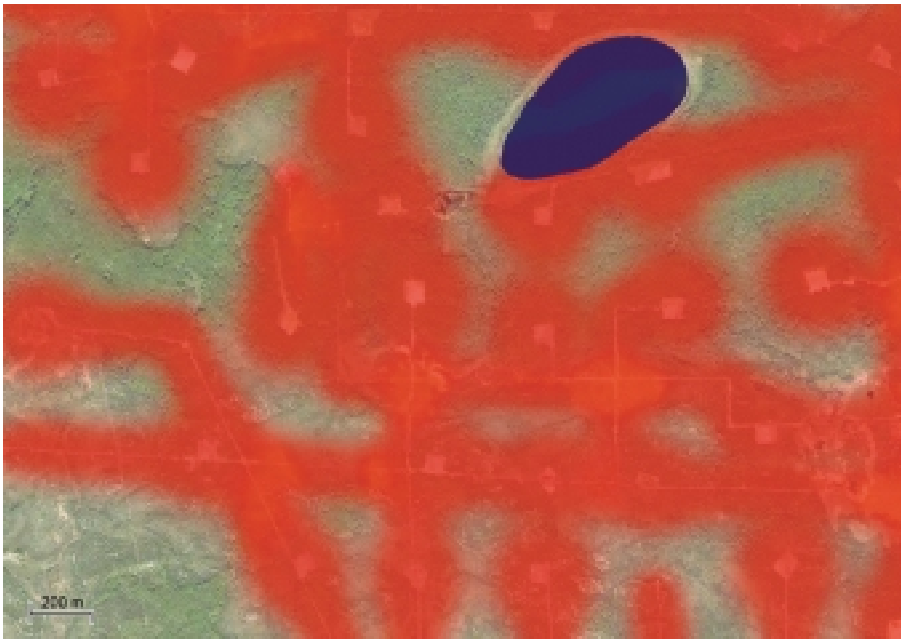
Project developers have acknowledged a local risk to biodiversity as a result of SAGD developments[39] but have discounted regional impacts, ostensibly because they have been unable to quantify them. In lieu of understanding what the impacts might be, companies pin all hope on reclamation. For example, the Long Lake EIA states,

> *Ecological thresholds have not yet been established regarding impacts to biodiversity as a result of fragmentation by development. Until thresholds have been defined, it is difficult to quantify effects of development on ecosystem function. Although the actual effects on overall biodiversity and ecosystem function are not known, it is expected that biodiversity will also be restored to baseline conditions if reclamation is successful.*[40]

There are several reasons why this approach is untenable. First, reclamation is unlikely to be fully effective. The track record to date has certainly not been positive. According to the Long Lake EIA there is not even an objective of restoring the site to its previous state, just of being "capable" of returning it to the previous state.[41] Moreover, the EIA openly admits that some ecotypes simply cannot be restored: "Most wetland types in the lease will be more fragmented at closure than at baseline due to the permanent loss of portions of these types."[42] Another problem is that impact assessments are conducted in the absence of a cumulative impacts framework. In fact, this report represents the first attempt to quantify the total impact of proposed SAGD developments. Remarkably, EIAs ignore most future in situ development, even though thousands of square kilometres have

BOX 4. SPECIES IN DECLINE AS A RESULT OF INDUSTRIAL DEVELOPMENT IN NORTH-EASTERN ALBERTA

Caribou
Lynx
Marten
Fisher
Wolverine
Boreal chickadee
Rose-breasted grosbeak
Yellow-bellied sapsucker
Red-breasted nuthatch
Brown creeper
Various warblers



▲ *FIGURE 15: Satellite view of the Long Lake site showing wildlife avoidance zones (red) around roads and well pads (Source: same photo as Fig. 5, with 200 m buffers on roads and 300 m buffers on well pads).*

SOURCE: GOOGLE EARTH, ©2005 GOOGLE, IMAGE © 2006 DIGITAL GLOBE already been leased. Finally, although oil sands developers speak of the impacts as transient, the fact is that 40 years is equivalent to several generations for affected wildlife species. Given the vast area affected, there may be no breeding populations left for repopulating the sites even if reclamation is indeed successful.

Although precise ecological tipping points have not been defined, evidence is steadily mounting that ecological thresholds for many species are already being exceeded at current levels of industrial development in northern Alberta. We present evidence below for three animal groups for which research findings from the oil sands region are available. Other species are likely to be similarly affected, though only limited research has been done to date. Given that the impacts of SAGD development are much more intense and prolonged than conventional forms of petroleum development it seems likely that not only will ecological thresholds be greatly exceeded in the future, but several species may be extirpated from northeastern Alberta under proposed development trajectories.

▲ *Woodland caribou populations in the region have declined by 50% over the past 10 years. Government and industry studies predict caribou will be lost from areas underlain by oil sands under current development trajectories.*

PHOTO: WAYNE LYNCH

2.2.1. Caribou

Woodland caribou is one of the species likely to be extirpated from regions subjected to SAGD development. Caribou declines across Alberta have been correlated with the level of industrial development within their ranges.[43] In the past ten years, the East Side Athabasca River caribou herd, whose range overlaps much of the current SAGD development, has declined by almost 50% (Fig. 16). Studies have shown that forests within 1 km of roads and well sites tend to be avoided by caribou[44] and that roads further fragment caribou habitat by acting as barriers to movement.[45] It is believed that this fragmentation concentrates woodland caribou into smaller portions of their range, where they become more susceptible to predation by wolves.[46]

Three separate studies predict dire consequences for caribou under the current management regime. A government-led study concluded that woodland caribou will continue to decline unless limits to development and aggressive restoration of existing disturbances are implemented.[47] An industry-funded modeling study within the oil sands region determined that, due to projected industrial development, available caribou habitat

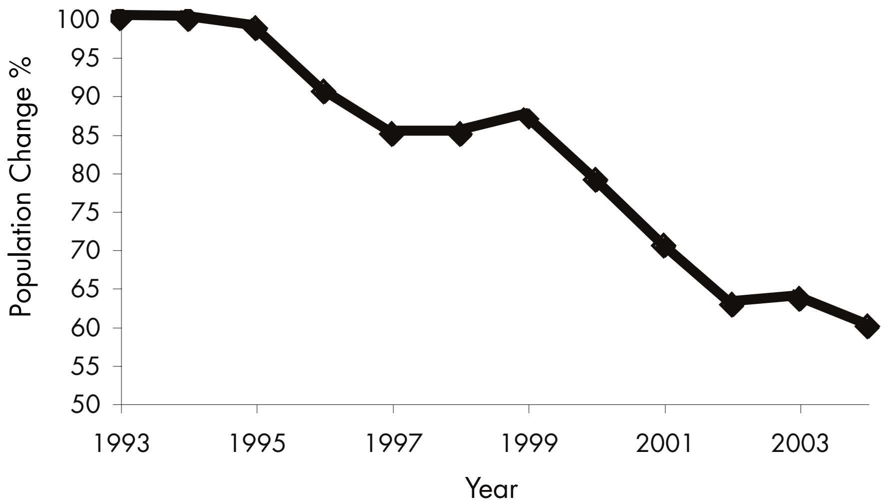


FIGURE 16: Population change of the East Side Athabasca River caribou herd from 1993 to 2004.

SOURCE: ALBERTA WOODLAND CARIBOU RECOVERY TEAM

The lynx in one of several mammals this is negatively affected by industrial development.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

will decline from 43% of the landscape to 6% over the next 20 years.[48] Finally, a study at the University of Alberta concluded that caribou will be extirpated from northern Alberta in less than 40 years if linear densities exceed 1.2 km/km^2 (less than half the projected linear density within SAGD developments).[49]

The consistent message is that, unless significant changes are made in the way we allocate and develop land for in situ oil sands production, caribou are likely to be lost from the entire oil sands region.

2.2.2. Furbearers

Furbearing mammals such as lynx, martens, and fishers are another group of animals negatively impacted by industrial development. A recent study has shown that population sizes have remained at expected levels in relatively intact regions of northeastern Alberta, but have significantly declined in regions subjected to industrial development (Fig. 17).[50] Researchers also found that declining population size is strongly correlated with road

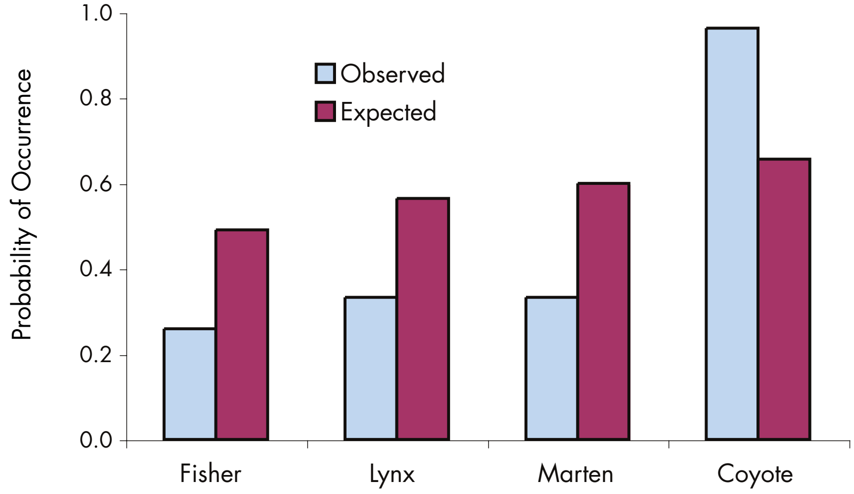


FIGURE 17: Probability of mammal occurrence in the Dry Mixed wood Boreal Region of northeastern Alberta: Observed vs.expected mean in intact forest.[50]

SOURCE: SCOTT NIELSEN, ERIN BAYNE, JIM SCHIECK, J. HERBERS & STAN BOUTIN

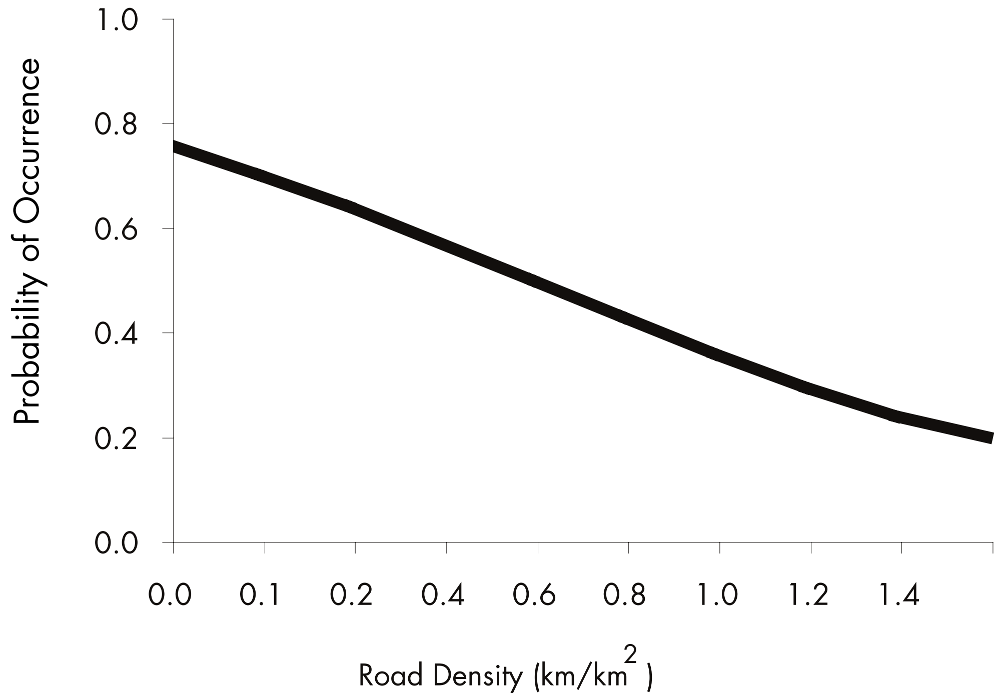


FIGURE 18: Probability of lynx occurrence in Alberta's Central Mixedwood Boreal Region relative to road density.[50]

SOURCE: SCOTT NIELSEN, ERIN BAYNE, JIM SCHIECK, J. HERBERS & STAN BOUTIN

density (Fig. 18). As the populations of sensitive species have declined, the abundance of species tolerant of disturbance, such as coyotes and deer, has increased (Fig. 17). The intense and prolonged disturbance footprint of SAGD developments will accelerate these trends, leading to further declines in furbearer populations and possibly the loss of species in many areas.

2.2.3. Forest Birds

Projections are also bleak for several forest birds, including some migratory species already of conservation concern as a result of previous industrial development. Many forest birds are sensitive to industrial disturbance and tend to avoid using otherwise suitable habitat within 100 m of roads, pipelines, well pads or similar features.[51]

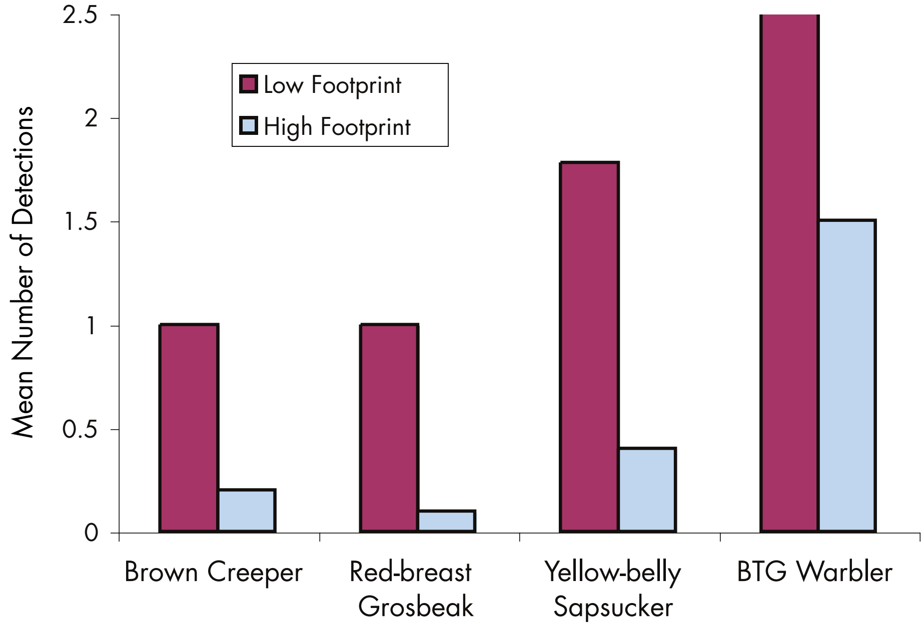


FIGURE 19: Abundance of four species of birds in northeastern Alberta relative to the intensity of industrial footprint (low, high).[53] *See Box 4 for full species names.*

SOURCE: STEVE G. CUMMING & FIONA A. SCHMIEGELOW

There is evidence that landscape effects, above and beyond local avoidance effects, are responsible for additional declines in the abundance of some species.[52] A recent study in northern Alberta determined that the abundance of some bird species was reduced by over 80% in townships with a high level of industrial footprint compared to relatively undisturbed townships (Fig. 19).[53] The declines in SAGD sites are bound to be even greater, given that the intensity of SAGD disturbance is substantially greater than that of the conventional oil and gas disturbances included in the bird study. The loss of some bird species from the oil sands region seems highly likely.

2.2.4. Other Environmental Impacts

Impacts of oil sands development on air and water have been reviewed in other reports and will not be covered in detail here. In particular, we refer readers to *Oil Sands Fever* and to *Troubled Waters, Troubling Trends.*[54] Some of the most significant impacts from in situ development are as follows:

- Depletion of freshwater reserves, either through direct use or through the secondary effects of drawing down saline aquifers (e.g., although the Long Lake project uses saline water for steam production, draw-down effects are expected to reduce the flow of the nearby Gregoire river by up to 3.4%[55]);
- Damage to aquatic ecosystems from the disruption of normal flow patterns caused by roads and other industrial features;
- Acidification of land and water in the oil sands region (e.g., the Long Lake EIA predicts that some lakes in the region may acidify sufficiently to affect amphibian embryos[56]);
- Regional contamination of ground and water from thousands of tons of drilling wastes, production wastes, byproducts of upgrading, byproducts of desalination, and accidental spills;
- Conversion of wetlands such as fens and bogs to upland landscapes after reclamation; and
- Large increases in emissions of greenhouse gases.

▲ *Alberta's boreal forest is a mosaic of forests, wetlands, rivers and lakes.* PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

3 Solutions

We present here a suite of government policy options and industrial best practices that, taken together, would reduce some of the environmental risks associated with in situ oil sands development. It is important to note that industrial best practices are insufficient in the absence of clear policy and regional planning designed to balance environmental protection and industrial development. This is particularly relevant in the case of oil sands development given the intensity and pace of development on the landscape.

All of our recommendations are based on specific examples of policies and best practices that have been implemented either in Alberta or elsewhere in North America, and are directly applicable for in situ development in northeastern Alberta. Unfortunately, although practical, these approaches have generally not been widely adopted to date. Our hope is that by drawing attention to these workable solutions, while showing the perils of maintaining the status quo, these approaches will become standard practice under a new regulatory framework for in situ development in Alberta.

3.1 Policies and Planning

Although industrial best practices will be beneficial, it is clear that even with state-of-the-art practices the cumulative ecological impacts of in situ development will be devastating. By their very nature these projects are inextricably linked to an intensive, widespread, and long-term disturbance footprint. Even if individual disturbances are reduced in size, the sheer number of seismic lines, core holes, roads, well pads, pipelines, and other infrastructure components, along with a large central facility, will greatly exceed the tolerance limits of many wildlife species.

As the limitations of industrial best practices have become more apparent there has been a growing consensus that additional measures will be needed to manage the impacts of rapidly expanding industrial development in Alberta. The Alberta Chamber of Resources, an industry group that has pioneered voluntary partnerships to reduce the impacts associated with overlapping developments, acknowledges that limits to land uses are inevitable in order to maintain environmental values.[57] In a recent survey commissioned by the Alberta Forest Products Association, 75% of respondents felt that the government needs to put limits and set priorities on who is able to use the forest, how, when and where.[58]

If there is to be any hope of balancing ecological and economic objectives in the boreal forest of Alberta, then new approaches to land management supported by appropriate policy and planning frameworks in a broad regional context will need to be implemented. Developing and implementing these new policies and planning frameworks will require leadership by both government and industry. In the following sections we outline some of the key elements that should be considered.

3.1.1. Protected Areas

To maintain the full complement of native species in the oil sands region in the face of widespread in situ development, parts of the landscape will have to be set aside as wildlife reserves. The establishment of such reserves can be thought of as a conservation offset measure (i.e., an action taken to offset or balance ecological losses resulting from intensive industrial activity). Unless this step is taken, species will be lost.

To effectively serve as reservoirs of biodiversity the reserves will need to meet several criteria. First, the sites must be fully protected from industrial use, including both petroleum development and forestry. Second, the sites should be part of an integrated system designed to provide full representation of Alberta's boreal ecosystems (in which the oil sands lie). It follows that new sites should emphasize ecosystems not well represented in existing protected areas. Third, the sites should be large enough to support viable populations of native species and to maintain natural ecological processes. This implies a size of several thousand square kilometres – sufficient to withstand the large fire events that are a key driver of ecological function in the boreal forest. Given that oil development in the region is projected to last well into the next century, the wildlife reserves should be permanent entities. A designation of Wildland Provincial Park, which permits traditional uses but prevents industrial activity, would be most appropriate.

Besides serving as reservoirs of biodiversity, protected areas also play a vital role as ecological benchmarks. Monitoring within these areas provides important baseline data that can be used to assess ecological changes in the industrial landscape as part of an adaptive management system. Further, they can serve as representative areas of ecological integrity for ongoing research into improving reclamation of oil sands developments. Protected areas also serve as important sites for traditional, spiritual and recreational uses. Finally, the preservation of wilderness as an end in itself is a high priority for the public.[59]

Currently, Wood Buffalo National Park serves as the core protected area for Alberta's boreal region. While of immense ecological value, much of this park is centred around a unique delta system that has different characteristics from the forests found in the oil sands region. The park is also north of the oil sands region, which means that it has a different climatic regime. As a result, many species typical of the boreal forest found in the oil sands region, including woodland caribou and a variety of song birds, are not found in the park. Therefore, notwithstanding Wood Buffalo National Park, there are still many gaps in the existing system of protected areas that need to be filled.

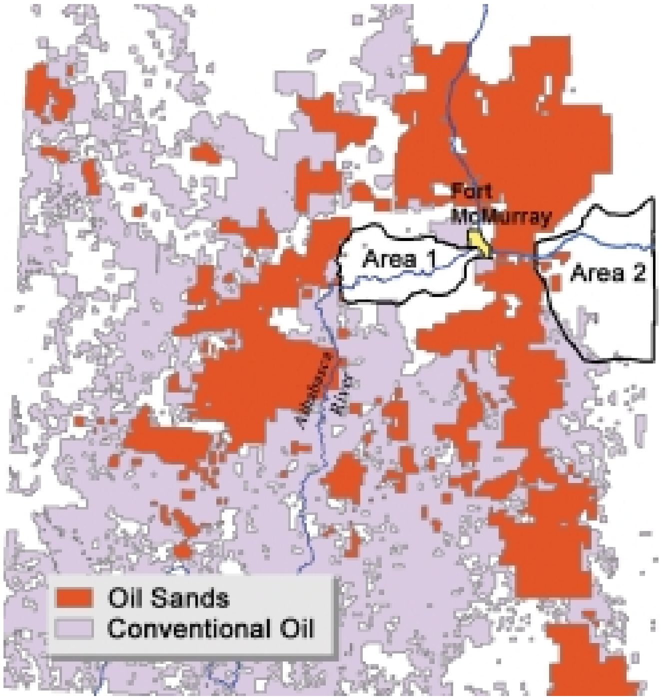
Much of the technical groundwork for identifying priority areas for protection in the boreal region has been done. It is beyond the scope of this paper to discuss all of the candidate sites and the selection methodologies used. Instead, we refer the reader to the relevant literature.[60] But it is worth highlighting two prospective sites of high ecological value that exist in the heart of the oil sands region, near Fort McMurray (Fig. 20). What makes these sites of particular interest is the fact that they are largely devoid of recoverable oil deposits, even at today's high oil prices. Oil and gas leases are virtually absent in these sites (Fig. 20) and their protection could proceed with minimal conflict with the petroleum sector. Furthermore, the major forestry company in the region, Alberta-Pacific Forest Industries, has been actively pursuing legislated protection of these two sites (albeit using somewhat smaller boundaries) under its ecological benchmark initiative.

Some oil sands operators have begun to support the conservation offset concept. For example, several have written letters of support for the Alberta-Pacific Forest Industries ecological benchmark initiative. Some are also beginning to incorporate the need for ecological benchmark areas into their EIAs. For example, the EIA for the Imperial Oil Kearl Oil Sands Project identifies the need for regional ecological benchmark areas as reference areas to compare to reclaimed portions of project leases.[61]

Because the oil sands lie largely on public lands, responsibility for the establishment of new protected areas in the region rests largely with the government. However, since the end of Special Places 2000 there has been no process in place whereby discussions leading to the establishment of new protected areas could take place. Alberta Sustainable Resource Development should lead the establishment of new interconnected protected areas representative of the boreal region as part of a broader land use strategy for the region.

3.1.2. Protection of Private Lands

A more direct approach to conservation offsets being explored by some oil sands companies is the purchase of privately held forested land in the Peace River region. As a conservation offset measure, this approach has much merit. The main limiting factor is that it is difficult



▲ *FIGURE 20:*
Candidate protected areas (black lines) near Fort McMurray in relation to petroleum leases. The two areas outlined are 1,700 and 3,300 km² in size, respectively.

SOURCE: CANADIAN PARKS AND WILDERNESS SOCIETY

RECOMMENDATION

Alberta Sustainable Resource Development should establish new interconnected protected areas representative of the boreal region as a conservation offset measure.

Conservation offset areas should be established.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

to assemble large contiguous blocks of protected land, given the high cost of land and the fact that not all land is for sale. Also, as in other areas of the province, ownership of the land does not extend to subsurface rights. Unless the areas are formally designated as protected areas by the government, oil and gas development can still occur.

Protection of private land can take the form of purchasing and donating lands in partnership with conservation organizations or through purchasing conservation easements. Suncor's involvement as a founding member of the Boreal Habitat Conservation Initiative is a good example of how this can be accomplished in practice. Suncor has committed to invest a total of $1.05 million over three years to help the Alberta Conservation Association secure boreal forest habitat that will be turned over to Alberta Parks and Protected Areas for ongoing stewardship and management.[62] This commitment builds on an agreement between the Alberta Conservation Association and Suncor that started in 2003, when 190 ha of land were purchased or secured through protective land use reservations in the Winagami Lake area of northwestern Alberta to offset habitat affected by oil sands operations in Fort McMurray.

3.1.3. Regional Planning

The most effective application of the conservation offset concept will be achieved if the efforts of individual companies and the government are coordinated through regional planning. The same can be said of wildlife movement corridors, conservation of old growth, and indeed any regional management objective. However, there is currently no regional plan that demonstrates how future oil sands development will be integrated with protecting the regional environment. Whatever the desired future may be for northeastern Alberta, it cannot be achieved without a common blueprint.

Arguably the most important element of regional planning is the allocation of tenure, including the decision about which lands to lease for oil sands development. Tenure decisions can be linked to an identification of priority land uses, but in most regions of Alberta this type of planning is not done. It is at this stage where the greatest latitude exists for directing the timing, location, and intensity of development at the regional scale. Once tenure rights have been allocated, discussions focus narrowly on mitigation measures to minimize cumulative impacts. We have demonstrated in this report that a failure to consider environmental objectives in the allocation process poses significant risks to the boreal forest landscape.

Successful Tenure Approaches

The Muskwa-Kechika region of northern British Columbia is a good model of how pre-tenure planning for petroleum development can be successfully applied. The Muskwa-Kechika Management Area Act requires that pre-tenure plans, which provide binding directions on oil and gas developments, must be prepared by government prior to the issuance of oil and gas tenures.[63] Pre-tenure plans include landscape objectives and quantitative numeric thresholds for land-based disturbances. This approach provides both certainty of appropriate access for petroleum companies, while ensuring cumulative limits to disturbance are not exceeded and environmental values are protected. The need for pre-tenure planning is broadly supported by many stakeholders:

> *The April 2003 Muskwa-Kechika pre-tenure plan truly adopts a result-based management framework. The plan does an excellent job in incorporating views from a diverse set of stake-holders and generating a useable plan to guide oil and gas activity in the Muskwa-Kechika".*
>
> ***Shira Mulloy,***
> ***Canadian Association of Petroleum Producers***[64]

The logical planning process in the Muskwa-Kechika is in contrast to the disposal of in situ oil sands leases in Alberta, which occurs without any landscape-level strategic planning. The only review that occurs prior to tenure allocation is by the multi-departmental Crown Mineral Disposition Review Committee, which is expected to highlight any environmental restrictions associated with individual land parcels. This process is closed to the public and does not solicit stakeholder input. In the absence of a cumulative impacts framework the committee has not had any discernable effect in influencing the location or rate of in situ development. It has been argued that the lack of transparency, accountability and formal mandate for this committee also contributes to its ineffectiveness.[65] Over 3.5 million hectares of boreal forest have been leased for intensive in situ development in Alberta without a long-term landscape plan, and new leases continue to be awarded at a record pace.

We recommend that a regional land management plan be developed, and that no further tenure allocations be made until this plan is in place. Slowing down the rate of petroleum development is a prudent step in any case, given the severe labour and infrastructure shortages facing the province from oil projects already under way.

The regional plan should include a comprehensive environmental baseline, characterizing northeastern Alberta prior to industrial development (i.e., circa 1950). This baseline should serve as the reference against which the impacts of future developments are compared. Current government expectations require companies to present their projects in the context of the landscape condition at the time of application, ignoring the progressive regional-level deterioration in environmental indicators.

The plan should also include a clear expression of public values, expressed as long-term management objectives for the region. This can be achieved through a description of the desired future landscape along with the societal benefits to be derived from it.

Finally, the plan needs to include directives for implementation. These should include land use designations and quantitative management targets, such as maximum levels of disturbance and road densities that can guide tenure allocations, as in the Muskwa-Kechika. Making the bridge between public values and an implementation plan is the most difficult step because trade-offs are invariably necessary. The best approach for grappling with such tradeoffs is to use future scenario modeling, wherein the state of the landscape under alternative management approaches is projected into the future using computer models. The Sustainable Ecosystem Working Group of the Cumulative Environmental Management Association has recently undertaken a project to do just that, and results will provide valuable insights for the future management of the oil sands region. However, the continued allocation of lands for in situ oil sands development before this assessment is complete is of grave concern.[66]

RECOMMENDATION

Alberta Sustainable Resource Development should develop a regional plan for in situ development that will protect the boreal forest. Alberta Energy should suspend new tenure allocations and Alberta Environment should suspend new project approvals until the regional plan is in place.

◀ *Maximum allowable levels of disturbance should be established.*

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

3.1.4. Cumulative Effects Thresholds

Quantitative thresholds are a useful way to manage environmental impacts associated with development activities. Numeric limits for air and water emissions are entrenched in management decision-making, both as project-specific thresholds and regional targets. Despite the potential efficiencies involved in incorporating land-based thresholds, Alberta has resisted incorporating thresholds into land-based decision making, particularly with respect to the oil and gas sector.

Since thresholds for cumulative industrial impacts have not been implemented in Alberta, as a result, forested lands in northern Alberta are being transformed by an industrial footprint that is steadily increasing in extent and intensity. The issue is exacerbated by the fact that most areas are subjected to impacts from multiple industrial operators (e.g., oil sands, conventional oil and gas, hardwood forestry, softwood forestry). Alberta's boreal forest is well on its way to becoming one large intensive use zone, with disastrous consequences for biodiversity. This is at odds with public values and government commitments to sustainable development.[70] A balance between economic and environmental values must be achieved, either by fully protecting a large proportion of the land base or by protecting a smaller proportion but setting strict limits on the intensity of development in the industrial areas. The examples cited above from surrounding jurisdictions demonstrate that workable solutions do exist.

Threshold Approaches Example 1: The Muskwa-Kechika Management Area

The Muskwa-Kechika provides a working model of how land-based cumulative effects thresholds can be put into practice. In the Muskwa-Kechika, habitat thresholds vary depending on the nature of the planning area, as defined in pre-tenure plans.[67] For example, for the Halfway-Graham region, 23% of the 234,902 ha area may be impacted by oil and gas activities. This includes both the physical infrastructure (roads, well pads and pipeline corridors) associated with oil and gas developments, and the 'zone of influence' around these developments. The zone of influence is an area around a disturbance feature where impacts to environmental values may be felt. To determine whether new developments can be accommodated within the thresholds, development plans are overlaid on habitat maps for six different wildlife species. Disturbances are time limited, and when they are decommissioned and restored they no longer contribute to calculation of cumulative effects thresholds.

Threshold Approaches Example 2: The Dehcho Land Use Plan

The Dehcho Land Use Plan, for the Dehcho territory directly north of Alberta, is another excellent model for the establishment of land-based thresholds.[68] Opportunities for industrial development are provided in development zones, provided that thresholds are not exceeded. The plan is flexible, and provides clear direction regarding management options when the thresholds have been reached. The draft plan provides proposed land use thresholds for road density, total linear density, habitat availability, core areas and stream crossings.Thresholds are based on best available scientific information about the response of wildlife species to industrial development.[69]

RECOMMENDATION

Alberta Sustainable Resource Development should establish quantitative limits on cumulative industrial disturbances and precautionary standards for wildlife habitat to ensure that ecological thresholds are not exceeded and environmental values are protected.

Most areas are exposed to multiple forms of development.

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

3.1.5. Coordination of Operational Planning

In addition to a broad regional strategic plan, a framework is needed to guide the development of integrated operating plans to ensure that different industries operating on the same landscape coordinate their development activities. Integrated planning is too important to leave as a voluntary industrial best practice with inconsistent implementation. Moreover, it is not just companies that need to be integrated at the operational level, but also individual government departments, which often have conflicting management objectives and regulations.

Although the Alberta government has been working on the issue of integration, a workable solution has not yet been forthcoming. A recent Information Letter recommended that energy and forestry operators discuss requirements for joint infrastructure, but it was limited to a small planning area northwest of Nordegg.[71] While coordination of development was a core element of the draft *Mineable Oil Sands Strategy*, the focus was primarily on coordinating mining projects, and there was no attempt to balance environmental and economic values.[72] The *Forest Management Planning Standard* provides perhaps the most useful template for coordinated planning.[73] It includes a framework and a list of landscape-scale management indicators that forestry companies must use when developing their integrated forest management plans. However, no attempt has been made to expand the scope of this document beyond the forestry sector.

We recommend that a *Land Management Planning Standard*, modeled on the *Forest Management Planning Standard*, be established to guide the development of operating plans for all resource companies working in a given management area. The standard would compel companies to collaboratively devise workable integrated solutions for achieving shared landscape-scale land management objectives. A single government agency dedicated to integrated land management should be established to provide oversight and facilitation of this process. A key role for the government is to ensure that the solutions companies devise are equitable, and consistent with regional land management and conservation objectives.

3.1.6. Requirements for Lease Evaluation

The *Oil Sands Tenure Regulation 50/2000* is an impediment to sustainable land management. The regulation generally requires that oil sands proponents drill one evaluation well in each section (square mile) in not less than 60% of the sections within their oil sands lease to evaluate the nature of the oil sands resource. This means that before an EIA has been completed, or an in situ project is approved, a significant level of land disturbance has already taken place. This is of critical importance in woodland caribou ranges in northeastern Alberta, where levels of development generally already exceed maximum levels required to maintain caribou populations in most areas.

Part 6 of the *Oil Sands Tenure Regulation* enables the Minister of Energy to prescribe an acceptable level of evaluation that is less than that identified above. It is unclear if this flexibility is ever exercised by the minister. We recommend that the government consider the requirements for evaluation in terms of landscape impacts, and either lower the minimum evaluation requirement, or provide guidance whereby the minister may waive evaluation requirements in order to mitigate landscape impacts.

RECOMMENDATION

Alberta Sustainable Resource Development should establish a Land Management Planning Standard, modeled on the Forest Management Planning Standard, to guide the development of operating plans for all resource companies working in a given management area.

3.2 Industrial Best Practices

Although improved industrial practices alone will not be sufficient to avert severe declines in biodiversity and other environmental problems in the forests of northeastern Alberta, best practices will be important for keeping in situ developments below ecological thresholds and generally tempering the cumulative impact of proposed developments. In the sections below we outline some of the key practices that could and should be put into widespread use. The Departments of Sustainable Resource Development and Energy should require these practices as minimum standards for in situ development.

RECOMMENDATION

All government departments should establish minimum standards, reflecting industrial "best practices," that companies must employ to minimize damage to the boreal forest.

3.2.1. Seismic Exploration

Seismic lines account for the majority of the linear disturbance associated with in situ development. The average seismic program associated with a SAGD project includes approximately 1,000 km of line cutting.[74] Minimizing the seismic footprint is essential if environmental values are to be protected in northeastern Alberta.

There are several problems with conventional seismic lines. First, they are perceived by wildlife as gaps in the forest, affecting their movement and territory establishment.[75] Second, because regeneration is extremely slow, the lines usually become long-term features on the landscape.[76] Finally, conventional lines often become used as human access corridors, with various secondary effects. Seismic operators need to address all of these issues. Given the enormous number of lines being cut, the working objective should be to cut seismic lines that have no discernable ecological effect within five years.

Reducing the width of lines and installing barriers to travel are the two main approaches for reducing the ecological impacts of seismic lines. The seismic industry in general is making excellent progress in this regard. Although the minimum width at which lines are no longer perceived as ecological features has yet to be determined by scientists, preliminary evidence suggests that the 2.5 m lines being cut by some operators are an appropriate interim target for 2D programs. Because the density of seismic lines in 3D programs is usually extremely high, hand-cut lines and heliportable techniques should be predominantly used for these developments.

If new lines 1) are cut at minimal width, 2) do not disturb the soil and root systems, and 3) include barriers to motorized access, then anecdotal evidence suggests that no extra effort (or cost) is required for reclamation. The lines appear to be visibly reintegrated into the forest within five years.

3.2.2. Bitumen Extraction and Processing: Alternatives to SAGD

The infrastructure, water and energy needs, and wastes associated with in situ developments are far greater than those associated with conventional oil and gas operations. As described earlier, the cumulative impacts of proposed in situ developments using SAGD technology would be ecologically unsustainable if all were to proceed. It is imperative that alternatives to SAGD that are less environmentally destructive be developed and implemented as rapidly as possible.

Two alternative approaches, now in the pilot phase, are VAPEX and in situ combustion.[77] These new technologies have the advantage of not requiring external energy or a large central facility to create steam, which may reduce the disturbance footprint associated with this extraction practice. They also have substantially reduced water and energy requirements, as well as emissions of greenhouse gases.

Another promising alternative in situ technique, now undergoing field testing, is electrical heating.[78] This technique has been used throughout North America for bioremediation and is now being applied to the oil sands. The process involves passing an electrical current from surface power distribution equipment to large vertical underground electrodes placed in a grid pattern (Fig. 21). The electrical current heats the bitumen and vertical production wells bring the heated fluid to the surface. This approach is highly efficient and is expected to produce an equivalent volume of bitumen in a tenth of the time required by SAGD, while using substantially less energy. The process also uses substantially less water than SAGD. The short duration of the project is a key feature because it means that any disturbances would approximate transient natural disturbances to which wildlife species are adapted, as opposed to extended SAGD disturbances that are likely to result in the extirpation of species.

3.2.3. Well Pad Construction and Reforestation

One of the main concerns associated with in situ well pad development is the risk of long-term loss of forest productivity and habitat potential. Northeastern Alberta is dotted with thousands of abandoned well pads from earlier oil and gas activities that are classified as reclaimed, but have not returned to a forest ecosystem.[79] Most of the delay in reforestation has to do with inadequate care of the sites during the initial clearing process and with inadequate reclamation objectives and regeneration techniques at closure. Given the large number of new wells anticipated with in situ development, it is critical that better approaches to well pad development and closure be implemented.

▲ *FIGURE 21: Electrodes.*
PHOTO: E-TENERGY

One of the key steps for reducing the impact of well pads is to reduce the spatial and temporal extent of their footprint. Specific practices that can be undertaken are as follows:

- Minimize the area affected by clearing the minimum area possible for drilling and then immediately reforesting the majority of the site except for the actual well infrastructure;
- Minimize the number of exploratory core holes drilled, and ensure that they are reforested immediately;

- Minimize the number of well pads through directional drilling of multiple wells from the same pad and reusing existing well sites such as core holes when possible; and
- Reduce related infrastructure (roads, etc.) by maximizing the use of remote operating technology.

Another suite of best practices falls under the heading of minimizing on-site impacts:

- Avoid introducing native and non-native invasive plant species;
- Minimize long-term changes to the site by drilling under frozen conditions; this means avoiding stripping of top soil, using snow and slash for filling contours and constructing well pads, and avoiding the use of off-site materials for pad construction;
- Where top-soil stripping is unavoidable, ensure proper handling and storage to protect and retain natural propagules; and
- Leave construction slash whole.

Planning between forestry operations and oil sands could reduce road access and the amount of area cleared for industrial facilities.

PHOTO: DAVID DODGE, PEMBINA INSTITUTE

3.2.4. Integration with Forestry Operations

The majority of the area proposed for in situ oil sands development is also licensed for forestry development through Forest Management Agreements and quota holder licences. A significant reduction in the combined impact of these industries could be achieved through integrated planning. In particular, there are opportunities for placing forestry cutblocks in areas proposed for in situ infrastructure and for harmonized road construction. Reducing the road footprint is especially important because of the large ecological impact associated with roads (access issues, disruption of water flow, erosion, etc.).[80]

Integration of in situ oil sands development and forest harvest was first explored between Gulf Canada (now ConocoPhillips Canada) and Alberta-Pacific Forest Industries (Al-Pac) in the Surmont area. By overlaying development plans for the next 30 years, the companies were able to show that coordinated planning could result in a 34% reduction in overall road access and a 16% reduction in areas cleared for facility development.[81] In the integrated operational plan Al-Pac adjusted its harvest plans to coincide with the SAGD footprint. This offset the need to harvest elsewhere, reducing cumulative levels of disturbance. Timber harvested from these areas was transported using ConocoPhillips' well site roads, therefore reducing additional forestry road requirements.

Being able to coordinate activities between SAGD development and forestry operations is dependent on the presence of merchantable timber, the ability of forestry companies to change harvest plans, and a willingness to invest additional up-front resources in collaborative planning. The initial Surmont plan indicated that approximately $1 million in savings may be realized in road construction over the life of the project.[82] So far, ConocoPhillips has saved approximately $100,000 in associated tree clearing and Timber Damage Assessment costs.[83] By using ConocoPhillips' higher grade roads, Al-Pac also has reduced road construction costs and will slightly decrease haul cycle times. It is important to note that, although integrated operational planning is an effective mitigation tool to help minimize disturbance impacts of multiple land uses, the levels of disturbance associated with coordinated projects such as the Surmont project are still very high.

3.2.5. Footprint Restoration

The conventional approach to the restoration of seismic lines, roads, and well sites has been to simply plant grass on the site at closure. This has seriously delayed reforestation of these disturbances. A recent study found that 65% of seismic lines cut three decades ago are still in a cleared state.[84] As a result, there is a significant historic footprint that should be restored before in situ development begins in earnest. Serious attention must be paid to the reforestation of existing industrial disturbances before additional disturbances are added to the system. To more effectively mitigate in situ impacts, Alberta Sustainable Resource Development should implement reclamation standards that require in situ disturbances to be reforested to the same standards used by the forestry sector.

The importance of restoring existing disturbances as an appropriate best practice has been recognized by the Boreal Caribou Committee, a government–industry group developing recommendations for land management within caribou ranges in Alberta. Through computer modeling projections based on field data this committee concluded that aggressive reforestation of existing developments, and in some instances developing maximum thresholds for development, would be required to maintain stable caribou populations in northeastern Alberta:

> *Throughout the East Side of the Athabasca River (Caribou) Range, existing and future industrial footprints need to be reduced in order to sustain the caribou population. Both industry and government must establish innovative techniques and policies to develop the natural resources on a smaller footprint, while restoring historical footprints.*[85]

3.2.6. Monitoring of Biodiversity and Disturbances

There is a need to integrate resource management decision making with information about changes in biodiversity. There is currently insufficient information for in situ operators to be able to demonstrate their operations are not impacting regional biodiversity.

Development of an Alberta Biodiversity Monitoring Program (ABMP) was initiated in 1997. As currently designed, this initiative has the potential to be the most advanced and comprehensive biodiversity monitoring program in the world.[86] The ABMP consists of a grid system of 1,656 sites across Alberta where the presence of more than 2,000 different species will be monitored to determine changes over time.

The ABMP is supported by a broad range of stakeholders from government, the forestry and energy sectors and environmental organizations, and is currently in a pilot phase. For the ABMP to be fully operational in 2007, significant funding from a broad range of land users will be required.

Some in situ operators such as ConocoPhillips and OPTI-Nexen are piloting the incorporation of monitoring programs like the ABMP into their operations. Both projects has invested funds typically assigned to a project-specific monitoring program into sites monitored according to ABMP protocols. Consistent monitoring protocols across northeastern Alberta are essential to be able to determine regional level changes to biodiversity that could be associated with large-scale in situ developments.

There is also an urgent need to track disturbances as they occur. Despite the fact that land clearing by the petroleum industry now approaches that of the forest industry, the rate and distribution of landscape disturbance associated with petroleum development is poorly tracked by both government and industry. The Alberta Government does not track or report on cumulative terrestrial footprints, and reporting of disturbances by individual oil and gas companies is limited or absent. Without readily available information about the current status of the landscape it is difficult to make meaningful assessments about the progress of individual companies in reducing impacts, or to determine whether ecological thresholds are being exceeded.

A voluntary data collection pilot program by the Canadian Association of Petroleum Producers was planned for 2005, but was delayed to 2006.[87] Although an industry-sponsored program would be a positive step, what is ultimately needed is a province-wide land information system that provides up-to-date land use information for government, stakeholders and proponents to assist in the implementation of a sustainable land management framework.

Conclusion

In this report we have demonstrated that in situ development of Alberta's oil sands will result in unprecedented impacts to Alberta's forests and pose grave risks to regional wildlife populations. Existing in situ leases already total 3.6 million ha, which is more than ten times the size of the mineable oil sands region. To put this in perspective, we are talking of an intensive industrial use zone larger than Vancouver Island. If existing leases are subjected to the same industrial footprint as the Long Lake project then 296,000 ha of forest will be cleared for SAGD infrastructure and over 30,000 km of access roads will be built. Furthermore, new leases continue to be awarded at a rapid pace, and new technologies for extracting less accessible reserves are continually being developed. If the entire area underlain by oil sands is eventually developed, in situ infrastructure could impact almost 14 million hectares of forest – a land area the size of Florida.

Until now, environmental concerns about oil sands development have largely focused on the impacts of oil sands mines. In response, the government has suggested that extra conservation efforts will be undertaken outside of the 3,300 km^2 mineable zone to offset the damage done by the mining. The draft Mineable Oil Sands Strategy states,

> *To ensure current and future generations continue to enjoy wildlife resources, habitat and population objectives will be achieved within a regional and provincial context through regional and provincial programs.*

In reality, the lands outside the mining zone continue to be allocated for in situ development and there are no biodiversity objectives or plans at either the regional or the provincial scale. There is still no concrete evidence that the government of Alberta is acting upon its stated intent to establish an Alberta Biodiversity Strategy[88] – a strategy that could and should provide direction and support for the development of regional biodiversity objectives. Rather, as we have shown in this paper, declines in a number of monitored species indicate that ecological tipping points are already being exceeded in northern Alberta. Moreover, in situ development, proceeding at an unprecedented rate, is likely to push many species over the brink. Without a doubt, we are at a critical juncture with respect to land management in northern Alberta. Decisions made today will determine the fate of many wildlife species that are an important part of Alberta's, and indeed Canada's, natural heritage.

Conclusion

The current development trajectory is at odds with public values. According to a poll released by the Alberta Forest Products Association in 2006, 84% of Albertans believe that "Access and use of forests should be based firstly on preserving and protecting the environment and sustaining wild life habitat at the expense of sustained economic benefits and jobs."[89] This same poll also found that only 23% of Albertans believe that the oil and gas industry is doing a good job minimizing impacts in the forest and 67% do not believe that the oil industry is accountable in how it uses forest lands. In short, the petroleum sector is not meeting the terms of its social licence to access resources on public lands.

It is clear that Albertans would never support the idea of treating the entire boreal forest underlain by oil sands (an area the size of Florida) as a "write-off" area, yet this appears to be the implicit objective of Alberta's oil sands strategy. Changes to the current development trajectory will need to be made if the government is to meet its commitments to sustainable management of our forests and the maintenance of biodiversity. Fortunately, as shown in this report, solutions do exist – though the window of opportunity is narrow. A top priority is to develop a long-term plan for the region that defines where and when development is allowed to proceed, along with ecological thresholds limiting the intensity of development in any given area. The plan should also define where new protected areas are to be established. As illustrated in Fig. 22, changes to land use policy will provide greater benefits than operational-level integrated landscape management or best practices and should therefore be given the greatest attention. Given the current symptoms of environmental degradation and projected impacts under a business-as-usual approach, no new oil sands leases should be awarded or developments approved until this planning is complete.

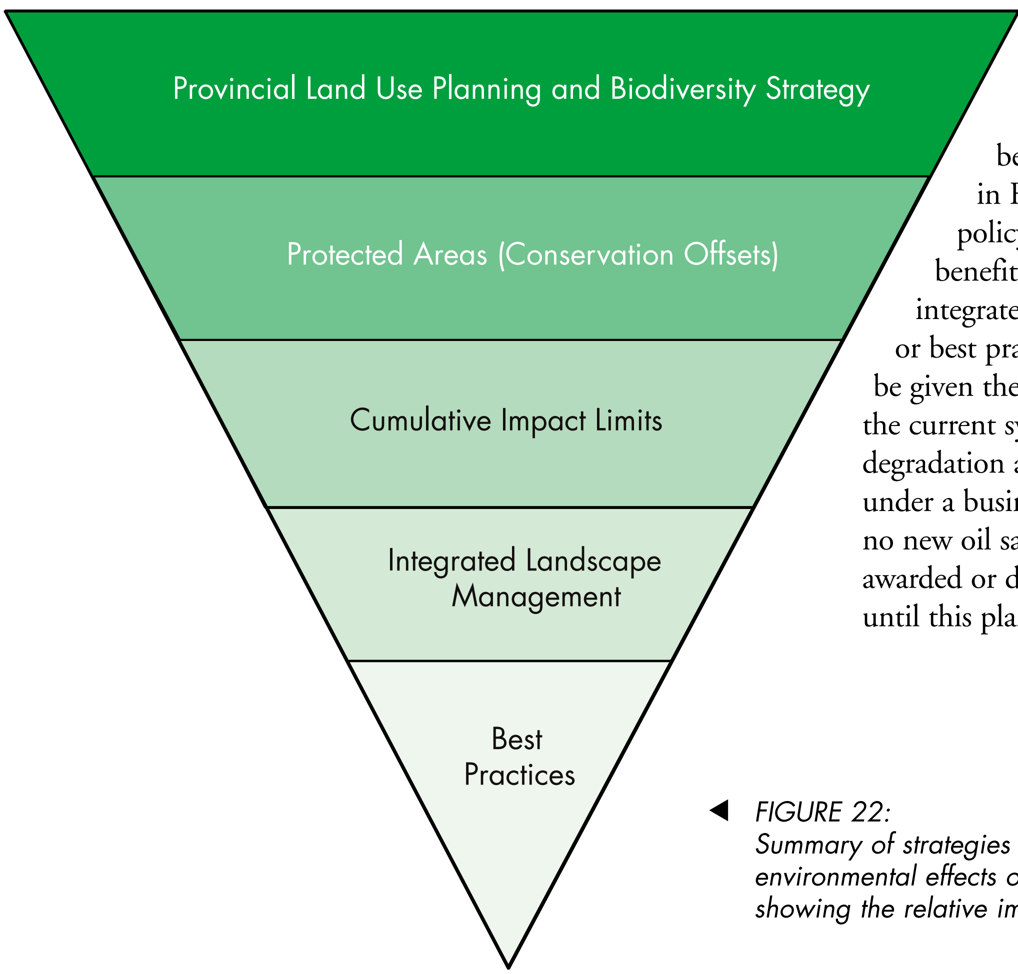


FIGURE 22: Summary of strategies for addressing the environmental effects of SAGD development, showing the relative importance of each.

Endnotes

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Death by a Thousand Cuts

Environmental concerns about oil sands development have mostly focused on the impacts of oil sands surface mines already visible from space, just north of Fort McMurray, Alberta. But this is just the beginning. Deep oil sands development has the potential to affect a forest area 50 times larger (an area the size of Florida) than the already leased oil sands mining areas and eventually cover 21% of Alberta.

Death by a Thousand Cuts: Impacts of in situ oil sands on Alberta's boreal forest examines the ecological impacts of one existing deep (or in situ) oil sands project and then uses that information to project the cumulative impacts of deep oil sands extraction across northern Alberta. Schneider and Dyer also examine alternative strategies of managing deep oil sands designed to help protect the boreal forest.

www.oilsandswatch.org
www.cpaws-edmonton.org
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