Decision Report NR2005-01
NRCB Application No. 0401

Birch Mountain Resources Ltd.
Muskeg Valley Quarry Project
Fort McMurray Area, Alberta

Natural Resources Conservation Board
Decision Report

June 2005

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Report of the Natural Resources Conservation Board
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1. INTRODUCTION

1.1 Application to the NRCB

[1] Birch Mountain Resources Ltd. (Birch Mountain) filed an application with the Natural Resources Conservation Board (NRCB or Board) on 22 March 2004, for approval to construct a limestone quarry located approximately 60 km north of Fort McMurray and 6 km east of Fort MacKay, Alberta (Appendix A).

[2] The *Natural Resources Conservation Board Act* (the *NRCBA*) enables an impartial public process to review projects that will or may affect the natural resources of Alberta. After having regard for the social and economic effects of a project and the effect of a project on the environment, the Board must determine whether, in its opinion, the project is in the public interest. A reviewable project cannot commence unless the NRCB has granted an approval for the project. The *NRCBA* requires a review of a project to construct a mine or quarry to recover any metallic or industrial mineral as defined in the *Mines and Minerals Act*, for which an environmental impact assessment (EIA) report has been ordered. The NRCB established a division of the Board consisting of Brady Whittaker (Chair), Gordon Atkins (Member) and William Kennedy (Acting Member) to consider the application.

[3] The application seeks approval to operate a commercial limestone mining operation and includes an assessment of environment effects of the following components:

- Limestone aggregate extraction activities for 30 or more years;
- Timber clearing and soil salvage;
- Waste rock stockpiling and in-pit disposal;
- Aggregate processing and shipping; and,
- Reclamation activities.

[4] Extraction, crushing and sorting activities are expected to average 5,500,000 tonnes/year during the first eight years. Peak production may reach or exceed 7,000,000 tonnes/year. A scale and loading facility comprising conveyer systems, aggregate product stockpiles and loading equipment will be constructed near the aggregate processing area. The quarry will result in a direct surface disturbance of 255 hectares of land.

[5] Birch Mountain holds the Metallic and Industrial Minerals Leases 9494070001, 9494070002, 9499030555, 9400080004, 9400080005 and 9400080006.

1.2 Scope of Review

[6] The Board has reviewed the application to conduct mining activities on the associated Metallic and Industrial Mineral Leases and is satisfied that the application materials provide sufficient information to assess the environmental, social and economic effects from the described activities.

1.3 Review Process

[7] Birch Mountain filed an application with the NRCB on 22 March 2004. Following independent reviews of the filed materials by the NRCB and Alberta Environment, consolidated requests for supplemental information were sent to Birch Mountain in July and November 2004. The information requested was determined necessary to complete the statutory mandates of the NRCB and Alberta Environment. Birch Mountain filed responses to the requested information in September and November 2004, thereby completing its application to the Board. During its consideration of the application, the Board requested additional information which was provided by Birch Mountain in March and April 2005.

[8] The NRCB review process is one component of a broader review process that provides for public involvement at various stages. Following public notice calling for statements of concern from interested persons, the NRCB determined that the review of this project had the potential to be completed without the need for a public hearing. Inherent in this assessment was the understanding that the affected public was made aware of the project, and had an adequate opportunity to familiarize themselves with potential project effects and to identify any potential concerns.

[9] Alberta Environment plays a key role in the NRCB review process through its participation in Birch Mountain's development of the EIA report that generates the majority of information contained in the application. Alberta Environment's involvement occurs during the development of the EIA terms of reference, the review of the EIA in terms of completeness, and participation in any NRCB hearing. In overseeing the EIA process, Alberta Environment also invites other government departments to participate to ensure the completeness of the EIA. For example, Alberta Infrastructure has provided input on issues related to transportation. Alberta Environment also has a significant role in relation to an NRCB approval. Section 9 of the *NRCBA* provides that the Board may grant an approval on any terms and conditions that it considers appropriate and particularly in those circumstances where a need is identified to achieve certain objectives. The rationale for any terms or conditions is to be set out clearly in the Board's decision.

[10] A review under the *NRCBA* differs from many statutory regulatory schemes in that the Board does not have an ongoing role in the regulation of the project or industry. As a result, the ongoing review and enforcement of conditions included in an *NRCBA* approval is normally delegated to a provincial department that has an ongoing regulatory function. The Board is careful to identify the appropriate delegate, most commonly Alberta Environment, to oversee the successful implementation of those conditions.

[11] In assessing the impacts associated with a reviewable project, the Board has regard for the regulatory environment governing activities associated with the project. For example, in this review, Alberta Human Resources and Employment (AHRE) ensures compliance with the *Occupational Health and Safety Act*, and associated regulations. In obtaining an understanding of the regulatory controls in place, the Board believes it is also in a better position to understand the potential of the operation to affect both the workforce and those who may find themselves on the quarry site.

[12] After consulting with Alberta Environment concerning the completeness of the EIA and completing its own review, the Board released a Notice of Application dated 9 December 2004 and published this notice in the Fort McMurray Today, Edmonton Sun and Edmonton Journal on 13 December 2004. Section 8 of the *NRCBA* provides that the Board is required to hold a public hearing only if it receives a bona fide objection from a directly affected individual or group of individuals.

1.4 Public Consultation

[13] Birch Mountain employed a multi-stage consultation process commencing in 2002. Consultation commenced with project disclosure to a number of identified parties, including Fort McKay First Nation, Mikisew Cree First Nation, Athabasca Chipewyan First Nation, The Regional Municipality of Wood Buffalo, Regional Issues Working Group, various individuals and corporations, and the Canadian Environmental Assessment Agency. Birch Mountain reported that its mining proposal was easily communicated to interested parties because the limestone extraction process employs straightforward and traditional quarrying practices.

[14] A critical element of ensuring public awareness is the public consultation program conducted by the proponent. The Board is satisfied that Birch Mountain conducted an adequate consultation process with all potentially affected parties. Birch Mountain also committed to conduct ongoing consultation should it receive an approval.

2. PROJECT NEED AND JUSTIFICATION

Views of the Applicant

[15] While the applicant provided limited information related to the project need, it advanced the view that demand exists for the limestone aggregate that would be produced from the project. Birch Mountain stated that there is a high current demand for aggregate in the Fort McMurray region associated with the economic growth driven by the oil sands industry. Regional sources of aggregate are declining and the remaining reserves cannot meet the growing future demand. In a survey conducted by the Regional Issues Working Group, regional industry identified the shortage of aggregate as the first limit to growth. Current sources for aggregate within the region were identified as having about ten years' future supply.

[16] Birch Mountain provided a summary of the net present value cash flow projection for the 31-year life of the project. The calculations indicated a significant return on the aggregate operation through the life of the project. Birch Mountain also summarized the direct economic benefits related to employment at the quarry, royalties payable to the Alberta government and municipal property taxes. It also summarized the economic losses to the forestry sector associated with the loss of land area for forest growth until reclamation of the quarry.

Views of the Board

[17] In considering the need for the project, the Board considers issues associated with the justification for the project, as well as the closely associated issues of project viability and the incremental or redistributive nature of the expected benefits from the project. The Board has given consideration to these matters, which are fundamental to the Board's determination of whether or not the application is in the public interest.

[18] In assessing the project's effect on the Alberta economy, the Board is cognisant of the industrial activity in the Fort McMurray region driven by growth in oil sands development. The Board is prepared to accept that the current strength of the bitumen industry will continue to create strong demand for aggregate throughout the region. The Board accepts the fundamental importance of oil sands production to the continuing strength of the provincial economy. While the Board accepts the basic viability of the project, the Board believes that the greatest justification for this development is the project's role in meeting future demand for aggregate associated with the present and anticipated pressure on the regional economy brought by oil sands development.

3. A BASELINE FOR IMPACT ASSESSMENT

[19] The assessment of environmental, social and economic impacts of a project requires a comparison of conditions anticipated with the project against the baseline conditions that would exist without the project. Any significant differences are attributed to the project and are described as the impacts of the project. Baseline conditions for proposed projects are defined in two parts: the current conditions that may be observed, and the future conditions that may be anticipated in the absence of the project.

Views of the Applicant

[20] The applicant described the project as being relatively large for an aggregate operation but relatively small in the regional context. Birch Mountain faced the challenge of having to assess the effects associated with a greenfield project surrounded by extensive existing and proposed industrial development. Baseline and cumulative effects are challenging to assess, having regard for the intensity and scale of the surrounding developments.

Views of the Board

[21] The Board has adopted the view that the assessment must consider impacts of both the construction and operation of the facility. The Board believes that the Birch Mountain application materials provide a reliable source of information to assess project impacts against the 'without the project' baseline.

4. ENVIRONMENTAL ISSUES

4.1 Air Quality and Human Health Effects

4.1.1 Air Quality

Views of the Applicant

[22] Birch Mountain concluded that the air emissions issues were related only to the quarrying of limestone and the preparation of aggregate. Birch Mountain considered, in its initial assessment of project emissions, the exhaust from sources such as the mobile quarrying equipment, on-site stationary diesel electric generators, diesel engines powering crushing operations and trucks transporting aggregate. In addition, particulates (i.e. $PM_{2.5}$, PM_{10}) were included in the emissions assessment. Particulates were attributed to aggregate crushing, screening, conveyance and road traffic. Birch Mountain stated that no other sources of air emissions were associated with this project.

[23] Birch Mountain employed the following approach and data sources in the initial assessment of air emissions:

- Existing EIA data from Syncrude Canada Ltd., Shell Canada Ltd., and Husky Energy, accessed through a data-sharing agreement,[1] were used extensively as sources of regional air quality measurements. Air quality data (1999-2002) from Fort MacKay air monitoring station, operated by the Wood Buffalo Environmental Association and from Deer Creek Energy's EIA of Jocelyn Phase 2 were also utilized.
- The dispersion of particulates <2.5 µm (i.e. $PM_{2.5}$) was modelled (i.e. ISCST3). Only emission rates were estimated for project-related TSP, PM_{10}, SO_2, NO_x, CO, GHG and metals.
- Meteorological data (1993-1997) were obtained from the 20 m level of the Mannix Tower.
- Predictions were made for four emission scenarios: project only case, approved case (i.e. observed emissions concentrations at Fort MacKay), application case (i.e. approved plus project-only emissions), and cumulative case (i.e. regional emissions).
- Predictions were developed for two operational cases (presence/absence emissions controls) and two mine pit depth scenarios (2.5 m, 27 m).

[24] Birch Mountain stated that emission controls could reduce the release of particulates by as much as 70%. Birch Mountain concluded that the most significant mitigation of $PM_{2.5}$ emissions occurred from the spray application of water on road surfaces and during crushing operations. Other mitigative measures to be implemented by Birch Mountain were routine maintenance of equipment to minimize exhaust emissions, installation of shields and barriers on crushers to limit escape of particulates, and control of blasting operations to minimize generation and dispersal of particulates.

[1] Application and Environmental Impact Assessment. March 2004. Section 3.4, p. 3-3.

[25] Based on an average of 1999-2002 measurements at the Fort MacKay monitoring station, Birch Mountain estimated the baseline $PM_{2.5}$ concentration to be 5.9 µg/m^3. Birch Mountain concluded that the baseline value was well below the Canada Wide Standard (CWS) of 30 µg/m^3. Birch Mountain predicted the ambient ground-level $PM_{2.5}$ concentrations (98th percentile, 24-hr.) at Fort MacKay and three other locations adjoining and within the project study area (i.e. Remote Camp, Trapper's Cabin, PTI Lodge). For all emission scenarios and all operational cases, predicted $PM_{2.5}$ values were below the CWS for both construction and full operational phases of the project and for both "no emission control" and "70% emission reduction" cases. Revisiting these predictions in response to a supplemental question, Birch Mountain ascertained that the project would contribute to $PM_{2.5}$ concentrations approaching or exceeding the CWS.

[26] Birch Mountain completed additional air quality modelling, as requested, to address questions regarding the human health risk assessment.[2] Additional ISCST3 dispersion modelling was completed on specific diesel exhaust constituents (i.e. CO, $PM_{2.5}$, PM_{10}, NO_2, SO_2), following speciation and screening of the emissions, based on toxicity and potential human exposure. Birch Mountain determined that no additional diesel exhaust chemicals were identified as contributing to 95% of the toxic load from this source. Emission rates for the individual diesel exhaust chemicals of concern (COC) were established by multiplying published emission factors[3] with an estimated diesel fuel consumption rate for the project (i.e. 7.3x10^6 L/yr). Overall emission rates for the COC were apportioned to different operations within the quarry (i.e. earth moving, transportation of aggregate, transportation of waste, transportation of overburden). Overall emission rates associated with each of these activities were then apportioned among the specific equipment involved in the quarry operations. In addition, emissions from 11 aggregate transport trucks, 4 waste transport trucks and 1 overburden transport truck involved in project operations were included in the model. Birch Mountain estimated $PM_{2.5}$ and PM_{10} emission rates from combustion exhaust and fugitive sources using existing reports and publications.[4]

[27] Birch Mountain predicted 1 hr-, 8 hr-, 24 hr- and annual-based concentrations of the COC, at seven specific locations (i.e. fenceline max, Fort MacKay, PTI Lodge, Trapper's Cabin, Remote Camp, Shell, Maximum Point of Impact)[5] using the ISCST3 model for the project only scenario.[6] Birch Mountain discounted the exceedances to *Alberta Ambient Air Quality Guidelines* (*AAQG*) predicted at Maximum Point of Impact (MPOI), as this site occurred in the quarry and was therefore not applicable to a human health risk assessment. Elevated COC concentrations were also predicted at the fenceline. Birch Mountain attributed these values to the limitations of the ISCST3 model, which resulted in uncertainty and over-prediction at the fenceline.

[2] Second Supplemental Information Response. Nov. 2004. Section 1, pp. 1-1 to 1-6.
[3] Second Supplemental Information Response. Nov. 2004. Section 1, Table SIR2-A, p. 1-2.
[4] Second Supplemental Information Response. Nov. 2004. Section 1, p. 1-4.
[5] Predicted Maximum Concentration Point in Study Area.
[6] Second Supplemental Information Response. Nov. 2004. Section 1, Table SIR2-D, p. 1-5.

[28] Birch Mountain employed existing data in estimating the contribution of other existing, approved and planned operations in the area (i.e. CNRL Horizon Application, 2002; Deer Creek Energy – Jocelyn Phase 2 Application, 2004).[7] Hence, no regional dispersion modelling was carried out. Birch Mountain assumed the maximum background PM_{10} values to be equal to that of $PM_{2.5}$ at Fort MacKay, based on data assembled by True North Energy (Fort Hills Project, 2002). Baseline predictions at Fort MacKay (i.e. existing + approved case) were considered to sufficiently represent concentrations at the cabin sites at which modelling occurred.

[29] For the application case (i.e. existing + approved + project) and the CEA case (i.e. existing + approved + project + planned), Birch Mountain predicted that exceedances to the *AAQG* would frequently occur at the MPOI and, to a lesser extent, at the fenceline.[8] For the latter scenarios, at other specified locations, all predicted ambient air quality concentrations met the *AAQG*. Concentrations, for a number of parameters, were predicted to be routinely greater than 50% of the *AAQG*.

Views of the Board

[30] The Board agrees with Birch Mountain that the total amount of diesel fuel exhaust generated by the Muskeg Valley Quarry will be relatively small compared to other nearby oilsands projects (e.g. Shell Muskeg River Mine, Syncrude Aurora North Mine). It is reasonable to conclude that the ambient air concentrations of these exhaust compounds in the vicinity of the quarry will be lower than that from mega-projects in the vicinity. However, for all emissions and in terms of $PM_{2.5}$ and PM_{10} particularly, the Board believes the Birch Mountain development will contribute to the cumulative effects on regional air quality and this contribution needs to be quantitatively assessed. Birch Mountain used "shared data" (i.e. EIA data developed for other regional oilsands projects) in its approach to complete this task. In the absence of any original site-specific air quality assessment data for this project, the Board has limited confidence in the results of the Muskeg Valley Quarry air quality EIA. Birch Mountain stated that it would monitor ambient $PM_{2.5}$ levels at Trapper's Cabin to confirm concentrations predicted by dispersion modelling and to assure particulate suppression is effective and ongoing.[9, 10] The Board supports Birch Mountain's commitment to verify its air quality predictions, but believes it may be appropriate to measure parameters beyond $PM_{2.5.}$ The Board recommends that Alberta Environment consider including additional parameters in the air quality monitoring program. The Board further recommends that the verification of air quality predictions include the COC in Table SIR2-17.2.[11] Further, the Board believes Birch Mountain's commitment to "intermittent" air quality monitoring should result in a database that satisfies the statistical requirements for calculating 98th percentiles and enables valid comparisons with the CWS.

[31] The Board notes Birch Mountain's initial evaluation of background $PM_{2.5}$ data involved a comparison of a calculated annual average (5.9 µg/m^3) to the CWS (30 µg/m^3), a value which is based on the 98th percentile ambient measurement annually, averaged over three consecutive

[7] Second Supplemental Information Response. Nov. 2004. Section 1, Table SIR2-E, p. 1-5.
[8] Second Supplemental Information Response. Nov. 2004. Section 1, Table SIR2-F & Table SIR2-G, p. 1-6.
[9] Application and Environmental Impact Assessment. March 2004. Section 4.2.6, p. 4-12.
[10] Second Supplemental Information Response. Nov. 2004. Section 2.3.10.1, p. 2-6.
[11] Second Supplemental Information Response. Nov. 2004. Section 2, AENV/NRCB SIR #17, p. 2-32.

years. The Board believes this comparison is not statistically correct and therefore concludes the initial estimates regarding cumulative air quality impacts are in error. In this regard, the Board acknowledges the additional information[12] provided by Birch Mountain to address and correct this matter. The Board disagrees, however, with Birch Mountain's view that the use of 98th percentile values, in this case, is overly conservative.

[32] Birch Mountain estimated exhaust emission species from the mobile equipment operated at the Muskeg Valley Quarry. SO_2 emissions were based on 250 ppm sulfur content of diesel fuel.[13] The Board notes that low sulfur diesel fuel (LSD) marketed and used in Canada contains <500 ppm sulfur.[14] As of January 1, 1998, LSD is required to be used for on-road applications. Regular sulfur diesel fuel (RSD), containing <5000 ppm sulfur is used for off-road applications such as farming, forestry and marine. As the mobile equipment operated at the Muskeg Valley Quarry appears to fall into the off-road application category, the Board is unclear how Birch Mountain established the sulfur content of the diesel fuel. Consequently, the Board also remains unclear about the implications for SO_2 air quality predictions, if the assumed sulfur content of diesel fuel used at Muskeg Valley Quarry is underestimated. In this regard, the Board notes SO_2 (local 1-hr maximum, regional 1-hr maximum) was categorized as an air quality parameter having "moderate" environmental significance in the region.[15]

[33] Birch Mountain identified particulates as the primary chemical of concern (COC).[16] The Board notes Birch Mountain assumed that emissions from crushing and screening would be controlled by spraying water. Wheel entrainment emissions from haul trucks would be mitigated with road watering. The efficiency of watering, in mitigating emissions, was assumed as 70% for purposes of air dispersion modelling. The estimated value for efficiency was calculated by averaging the reported emission reductions of $PM_{10,}$ using water, in various operations such as coal yards, iron and steel plants, and roadways.[17] The estimated value for mitigation efficiency was extrapolated to Birch Mountain activities related to limestone mining and assumed directly applicable to $PM_{2.5}$. Blasting, drilling, exhaust and material drop from conveyors were not considered as operations subject to emission mitigation. Birch Mountain stated that the estimate of mitigation efficiency (i.e. 70%) was conservative, as the action of natural precipitation, in this regard, had not been considered. The Board agrees that control of particulate emissions from some sources by the application of water can be a very effective management approach for mining operations at the Muskeg Valley Quarry. However, in the absence of directly applicable data, the Board is uncertain as to whether emissions of $PM_{2.5}$ and PM_{10} from all the sources with "mitigation measures" (e.g. wheel entrainment emissions) can be consistently controlled to the extent estimated. Despite Birch Mountain's response,[18] the Board also remains unsure of the extent of contribution to particulate emissions from blasting and drilling operations, which have not been considered as a source. The Board believes these uncertainties are sufficiently significant to warrant verification of air quality predictions regarding particulate emissions, once mining operations are underway. The Board requires, as a condition, that Birch Mountain design

[12] Second Supplemental Information Response. Nov. 2004. Section 1, p. 1-1.
[13] Second Supplemental Information Response. Nov. 2004. Section 1, Table SIR2-D, p. 1-5.
[14] http://www.petro-canada.ca/eng/prodserv/fuels/6824.htm
[15] Supplemental Information Response. Sept. 2004. AENV/NRCB SIR #135, p. 158.
[16] Supplemental Information Response. Sept. 2004. AENV/NRCB SIR #134, p. 157.
[17] Application and Environmental Impact Assessment. March 2004. Appendix B, Table B2, p. 2.
[18] Supplemental Information Response. Sept. 2004. AENV/NRCB SIR #139, p. 162.

and implement a particulate air quality monitoring program to the satisfaction of Alberta Environment.

4.1.2 Human Health

Views of the Applicant

[34] Birch Mountain conducted an initial qualitative assessment of human health based on the prescriptive protocols outlined by the Canadian Council of Ministers of the Environment (CCME), Health Canada and the U.S. Environmental Protection Agency.

[35] Birch Mountain identified the following types of substances that could be released from the various sources related to the proposed quarry: diesel exhaust from heavy machinery operation, particulates (i.e. road dust, total particulates, $PM_{2.5}$ and PM_{10} fractions), inorganic chemicals leached from the washed limestone, and flocculants used in the sediment control program. However, Birch Mountain concluded that the only COC generated at the quarry with the potential to affect human health would be particulate matter, specifically $PM_{2.5,}$ produced by diesel exhaust and dust.

[36] Birch Mountain noted that the potential exposure media could be ambient air, groundwater and surface water. However, with the water management practices planned to ensure that surface water flowing off the quarry site would be controlled and compliant with criteria for release, Birch Mountain concluded that the release of chemicals into surface water or groundwater, affecting human health, would be unlikely. Birch Mountain also discounted the probability of significant human exposure, through dermal contact or ingestion, to the chemicals emitted by Muskeg Valley Quarry operations and deposited on skin, soil or vegetation. Inhalation was concluded to be the primary exposure pathway.

[37] Birch Mountain considered potential health effects for individuals present at four off-site receptor locations,[19] namely: Trapper's Cabin, Remote Camp, PTI Lodge, and the community of Fort MacKay. PTI Lodge is operated year-round and Birch Mountain considered this location as one where a hypothetical year-round occupant would be exposed to emissions.

[38] Birch Mountain stated that the Muskeg Valley Quarry vehicle fleet is very small relative to the fleets in other nearby projects (e.g. Shell Muskeg River Mine, Syncrude Aurora North Mine) and total diesel exhaust amounts would be relatively small. In the vicinity of these large projects, the concentrations of COC from emissions were found to be at acceptable levels. Birch Mountain advanced that it was reasonable to project that the ambient air concentrations of these compounds in the vicinity of the quarry would be lower and, therefore, also at acceptable levels.

[39] Air quality modelling predicted the maximum ambient air concentrations of $PM_{2.5}$, resulting from quarry activities. Predicted $PM_{2.5}$ concentrations, at the four receptor locations outside the quarry boundaries (i.e. 98th percentile, daily maximum), were all less than the CWS[20]

[19] Application and Environmental Impact Assessment. March 2004. Section 7.1.2.3, Figure 7.1.1, p. 7-4.
[20] Supplemental Information Response. Sept. 2004. AENV/NRCB SIR #132, p.155. Health Canada Reference Level for Particulate Matter is 15 µg/m^3.

of 30 µg/m^3 (i.e. 24-hr average, 98th percentile annual, averaged over three consecutive years), irrespective of whether measures to mitigate[21] particulate emissions were implemented.

[40] From the results of the qualitative human health risk assessment, Birch Mountain concluded that risks to human health were not expected. Regardless, as a commitment to reducing the impact of the project, Birch Mountain stated that mitigation measures would be implemented during drilling, blasting, loading, unloading, crushing and screening operations.

[41] In order to address the significant number of questions raised by reviewers of the human health section of the Muskeg Valley Quarry EIA, Birch Mountain revised the initial human health assessment to include additional detail and new information.[22] In this quantitative human health assessment, Birch Mountain provided the following:

- Identification of specific potential emissions related to the project (i.e. diesel exhaust, $PM_{2.5}$, NO_x, SO_2, PAH, CO, CO_2, benzene, toluene, ethylbenzene, xylene, N_2O, CH_4)
- Screening and selection of COCs based on human toxicological potential.
    - Chemicals that represented 95% of the total toxic potency (i.e. diesel exhaust, $PM_{2.5}$)[23] were carried forward into a quantitative risk assessment. VOCs and metals were assumed not to represent a significant toxic potential and were not assessed.
- Discussion of exposure pathways.
    - Inhalation was concluded to be the only complete pathway. Birch Mountain, by implementing risk management measures, reasoned that chemical substances would not enter into surface water or groundwater and, therefore, potential for exposure through ingestion or dermal contact would not exist.
- Exposure limits for the COCs.
    - For $PM_{2.5}$, Birch Mountain adopted the Canada Wide Standard for Particulate Matter (i.e.30 µg/m^3 - 98th percentile, 24-hr.). Alberta Environment has adopted this standard as an enforceable limit. A Reference Level of 15 µg/m^3 (24-hr), recommended by Health Canada (*Canadian Environmental Protection Act Federal-Provincial Working Group on Air Quality Objectives and Guidelines,* 1999) was also employed. Birch Mountain stated, however, the latter standard had no regulatory standing within Alberta Environment or the federal government.
- Scientific rationale for the use of $PM_{2.5}$ as a surrogate for all emitted diesel exhaust constituents.[24]

[42] From the results of the air quality modelling, Birch Mountain concluded that predicted ground level $PM_{2.5}$ concentrations (98th percentile, 24-hr) from Muskeg Valley Quarry would be less than the CWS at all receptor locations and all emissions scenarios (i.e. project only,

[21] Supplemental Information Response. Sept. 2004. AENV/NRCB SIR #137, Table SIR 137.1, p.160. "No mitigation" still involves water application for Crushing and Screening and Haul Truck Wheel Entrainment activities.
[22] Supplemental Information Response. Sept. 2004. Section 7.0, p. 7-1.
[23] Supplemental Information Response. Sept. 2004. Section 7.0, Table SIR 7.1.3, p. 7-6.
[24] Supplemental Information Response. Sept. 2004. Section 7.1.5.2, p. 7-9.

application case, CEA or cumulative case).[25] Exceedances to the Health Canada Reference Level for $PM_{2.5}$ were noted at the PTI Lodge and the Remote Camp in the absence of emission mitigation (application case). Predicted concentrations at the PTI Lodge were greater than the Reference Level, with or without emissions mitigation (cumulative case). $PM_{2.5}$ at the Remote Camp exceeded the Reference Level when no emission mitigation was applied (cumulative case).

[43] Birch Mountain calculated hazard quotients (HQ), based on exposure point concentrations of $PM_{2.5}$ and the exposure limit, for all combinations of receptor locations, emission scenarios and operational cases.[26] HQ values were all <1.0, except for the PTI Lodge location and Remote Camp location calculated using the Reference Level. The range of HQ values for the combination of all emission scenarios, receptor locations and operational cases was 1.17 – 1.73.[27] Noting the conservative assumptions applied in the calculations, Birch Mountain concluded that the marginal HQ exceedances >1.0 would likely not represent a health concern and PM-related health impacts arising from Muskeg Valley Quarry would not be expected.

[44] Birch Mountain also examined the incremental mortality and morbidity rates associated with exposure to $PM_{2.5}$ for baseline,[28] project, application case and cumulative case emission scenarios, using methodology described by the *Canadian Environmental Protection Act Federal-Provincial Working Group on Air Quality Objectives and Guidelines*. Predicted mortality, respiratory hospital admissions (RHA) and cardiac hospital admissions (CHA) risks indicated potential health risks would be associated with emissions from the quarry. However, Birch Mountain indicated that there are no criteria to evaluate the RHA, CHA and mortality estimated risks for acceptability.[29] Nevertheless, Birch Mountain noted Health Canada had used calculations for such risks to establish National Ambient Air Quality Objectives for $PM_{2.5.}$ Birch Mountain concluded that these risks were primarily associated with the scenarios lacking emission mitigation. With the application of emission mitigation measures, Birch Mountain stated that the Muskeg Valley Quarry emissions did not pose risks to human health.

[45] Birch Mountain was requested to identify individual COCs more completely; particularly those combined and listed as VOCs and metals. Birch Mountain provided a screening health assessment for all potential speciated emissions from the proposed project.[30] The amended list of COCs included CO, NO_x, SO_2, PM_{10}, and $PM_{2.5}$. These chemicals were evaluated in the risk assessment using the results of the updated air quality dispersion modelling.[31] For the updated results of the dispersion modelling, Birch Mountain addressed previous inconsistencies by using 98^{th} percentile data to predict the baseline concentrations of COCs.[32]

[25] Supplemental Information Response. Sept. 2004. Section 7.1.6.1, p. 7-10.
[26] Supplemental Information Response. Sept. 2004. Section 7.1.7.1, p. 7-12.
[27] Supplemental Information Response. Sept. 2004. Section 7.1.7.1, pp. 7-13 & 7-14.
[28] Supplemental Information Response. Sept. 2004. Section 7.1.7.2, p. 7-14.
[29] Second Supplemental Information Response. Nov. 2004. Section 2, SIR2 #17, p. 2-37.
[30] Second Supplemental Information Response. Nov. 2004. Section 2, SIR2 #17, p. 2-29.
[31] Second Supplemental Information Response. Nov. 2004. Section 1, p. 1-1.
[32] Second Supplemental Information Response. Nov. 2004. Section 2, Table SIR2-17.2, p. 2-32.

[46] For SO_2, NO_x, and CO, Birch Mountain estimated daily intakes from inhalation for a hypothetical child receptor (age 0.5 to 4 years) residing (24 hr/day, 365 days/yr, 4 years) at Fort MacKay, PTI Lodge, Trapper's Cabin, Remote Camp and on the Shell lease. Hazard Quotients (HQ) were derived for acute (i.e. 1-hr, 8-hr, 24-hr) and chronic (i.e. annual) exposures.[33] All HQs were <1.0. Birch Mountain concluded the risks associated with exposure to SO_2, NO_x, and CO would be minimal and adverse human health effects would be unlikely.

[47] As previously, Birch Mountain assumed PM_{10} concentrations equal to those of $PM_{2.5}$. The updated assessment of the exposure to particulate matter was conducted using the approach outlined above.

[48] For $PM_{2.5}$, Birch Mountain noted that 98th percentile background concentrations approached health thresholds and additional emissions caused regular exceedances to these thresholds. Birch Mountain stated that the addition of the 98th percentile predicted concentrations to 98th percentile background concentrations at each location resulted in an extremely conservative assessment. Birch Mountain indicated that using 98th percentile for background concentrations is not standard practice but was requested by Alberta Health and Wellness. Alberta Environment expects the use of an annual average value. Birch Mountain concluded that health risks would be much less when using recommended average background concentrations instead of the 98th percentile values.

[49] In the updated human health assessment, Birch Mountain re-calculated the probability of mortality, RHA and CHA due to $PM_{2.5}$ and estimated a risk of 7.4 mortalities per 100,000 population at the PTI Lodge. At Fort MacKay, mortality risks for baseline exposures to $PM_{2.5}$ were 0.127 per 100,000 population. Mortality risks at Fort MacKay for cumulative exposure (i.e. CEA + Project) to $PM_{2.5}$ were calculated to be 5.668 per 100,000 population.[34] Birch Mountain believed that these estimates further support the conclusion that the proposed project would not pose health risks to individuals in the area.

Views of the Board

[50] The Board notes that Birch Mountain completed its health risk assessment based on the conclusion that inhalation was the primary and the only complete pathway of exposure. The Board considered Birch Mountain's explanation that dermal exposure could be discounted because of the inherent toxicological properties of the COCs (e.g. low dermal bioavailability, toxic only when inhaled), and because of regional climatic factors which would limit extended exposure of bare skin (i.e. cold northern climate). The Board also considered Birch Mountain's rationale for concluding ingestion was a very minor pathway of exposure (i.e. release of COCs to the environment) to be greatly reduced by mitigation measures. With regard to the elimination of exposure pathways, the Board notes the absence of supporting data (e.g. literature, monitoring, modelled) and clarification regarding the details of final mitigation plans. As a result, the Board questions whether Birch Mountain's proposed risk management measures will be able to prevent substance releases to the soil, surface water and groundwater environment, such that ingestion and dermal pathways can be completely discounted. The Board notes potential substances that

[33] Second Supplemental Information Response. Nov. 2004. Section 2, Table SIR2-17.4, p. 2-35.
[34] Second Supplemental Information Response. Nov. 2004. Section 2, Table SIR2-17.5, p. 2-36.

could be released from the quarry, for which a quantitative assessment has not been conducted, include explosive residues, inorganic chemicals leached from mined/exposed/stockpiled materials and water-soluble bitumen compounds (e.g. petroleum hydrocarbons, napthenic acids and flocculants). In addition, the Board finds that the integrity of the settling ponds, constructed on potentially fractured bedrock and containing leachate, is an unaddressed concern.

[51] The Board has examined Birch Mountain's approach to assessing impacts to air quality and human health. "Data sharing" has meant that there has been very little site-specific air quality monitoring data employed in developing the predicted concentrations of COCs at the various receptor sites. Data from the station at Fort MacKay is the exception. The quality of the human health assessment, which examined only inhalation as an exposure pathway, is also fixed by the limitations of the approach taken for the air quality assessment. The Board notes the difference and potential significance of using concentrations of air quality parameters obtained through monitoring versus that estimated by dispersion modelling. Monitoring data will include all existing area sources, including that which is non-anthropogenic in origin. The results from dispersion modelling are solely dependent on input data (i.e. primarily estimated known anthropogenic emissions).

[52] The Board recommends that Alberta Environment require Birch Mountain to use site specific water quality monitoring to confirm its assumption that inhalation represents the only pathway of exposure to affect human health. The Board believes Birch Mountain should substantiate that its risk management measures are successfully preventing chemical substances (i.e. inorganic metals, explosive residues, flocculants, hydrocarbons) from entering surface water or groundwater.

4.2 Groundwater

Views of the Applicant

[53] Birch Mountain cited regional investigations that demonstrate groundwater flow in the project area follows a shallow gradient from east to west. Another study found that groundwater inflow from glacial drift accounts for 30-50% of Muskeg River stream flow in summer and 14-18% in spring. Birch Mountain stated that inflows from groundwater in the Devonian limestone formations would be small due to the low hydraulic conductivity of limestone and the scarcity of limestone exposures along the river.

[54] Birch Mountain stated that the Muskeg Valley Quarry would create a localized water table depression, with steeper hydraulic gradients radiating outward and lessening away from the pit. Groundwater would infiltrate from all directions. Birch Mountain addressed the potential concern that groundwater might flow from the Muskeg River to the quarry. It concluded that any such flow would be minimal due to the 200 m setback of the quarry from the river, the low hydraulic conductivity of the quarry units, and the declining slope of the bedding plane from the quarry to the river. Birch Mountain also stated that the elevation of the pit bottom on the western margin of the quarry (Phase 3) would be higher than the elevation of the river. When the proposed lake filled some time after mine closure, groundwater flows would again follow the shallow east to west gradient.

[55] Birch Mountain stated that the primary conduit for groundwater flow in limestone would be through fractures. In 2002, the company had seven boreholes drilled. The well logs record major mud-filled fractures[35] in the upper limestone units. Birch Mountain completed six of the seven test holes as piezometers. Estimates of hydraulic conductivity from five piezometers screened across the limestone units fell in a narrow range of 1 to 6.2 x 10^{-8} m/s, which is somewhat higher than the median value of 3.2 x 10^{-9} for the Upper Devonian formations in the region. Birch Mountain recognized that karstification and solution channels in the limestone could produce substantially greater hydraulic conductivities than those measured in the five wells. A single piezometer screened across the Cretaceous McMurray Formation, which lies above the Devonian limestone formations, produced a higher value of 4.9 x 10^{-7} m/s.

[56] Birch Mountain examined two scenarios to explore the potential contribution of groundwater inflow as a source of water to fill the quarry lake. The first scenario assumed hydraulic conductivities comparable to those measured in the test wells to calculate an inflow rate. The second scenario assumed a higher inflow rate that might occur, if hydraulic conductivities were affected by fractures in the limestone. Birch Mountain found that in both scenarios groundwater contributed a smaller portion of the water required to fill the lake, 5% and 24% respectively, than did surface water, assuming an estimated average surface water inflow.[36]

[57] Birch Mountain measured groundwater quality in the same wells it used to assess hydraulic conductivity. Total dissolved solids (TDS) were less than 500 mg/L in the upper units and increased to between 5000 and 9000 mg/L at depth. Dissolved aluminum, iron, manganese, selenium and sodium exceeded CCME water quality guidelines. Total phenols in the deeper wells exceeded the Alberta Tier 1 guidelines for aquatic life. Birch Mountain stated that the latter result could be suspect, because the phenol concentrations were not far beyond the laboratory detection limit.

Views of the Board

[58] The Board accepts Birch Mountain's prediction that the diversion of groundwater toward the mine would be temporary, and that the current east-west flow would resume when the lake was full. The Board lacks confidence in the company's two estimates of groundwater inflow into the pit, since the lower estimate is based on few data and the upper estimate appears to be arbitrary. Instead, the Board agrees with Birch Mountain's statement in the EIA that the magnitude of the impact of potential solution channelling and fracturing cannot be predicted with the data at hand. In light of this uncertainty, the Board believes Birch Mountain's estimates of groundwater infiltration rates are quite speculative and that better estimates can and should be developed by monitoring the inflow of groundwater into the mine.

[59] The estimate of the surface water contribution to filling the pit, based on the ratio of project and watershed areas, is likewise very crude. The Board believes a better estimate can be developed by monitoring flows in the unnamed creeks. With these qualifications, the Board is

[35] Supplemental Information Response, Sept. 2004. Annex A, p. 4-6.
[36] Birch Mountain also explored scenarios based on maximum and minimum estimated annual surface water inflows.

encouraged that the estimated time to fill the lake is relatively insensitive to groundwater inflow scenarios and is approximately 20 years, assuming the estimated mean surface water inflow.[37] The Board accepts that 20 years is a reasonable timeframe for the lake to fill.

[60] The Board notes that groundwater inflow accounts for a substantial portion of the flow of the Muskeg River. The contribution of groundwater is particularly critical in summer when it is believed to account for 30% to 50% of the water in the river. The Board therefore considered whether the Muskeg Valley Quarry might have an adverse hydrogeologically-mediated effect on the Muskeg River, by disrupting groundwater inflow. Although the local water table depression induced by the mine will disrupt the east-west groundwater flow into the river for the life of the mine, the Board believes that the magnitude of the effect should be small, if only because the quarry can intercept no more than a small fraction of the groundwater inflow to the river based on the relative lengths of the mine and the river.

[61] The significance of this small incremental effect can only be assessed in relation to the cumulative disruption of groundwater inflow by all of the planned disturbances in the Muskeg watershed.[38] As no information on the cumulative impact of development on groundwater inflows was available to the Board at the time of its decision, the Board could not assess the significance of the incremental effect of the Muskeg Valley Quarry. The Board notes, however, that the majority of larger disturbances with correspondingly greater potential to affect groundwater inflows have not yet affected the watershed. Based on this observation, the Board is reasonably confident that there is yet time to assess and respond appropriately to the cumulative impacts of development on groundwater inflows to the Muskeg River.

[62] The Board is satisfied that groundwater will not flow from the river into the shallow western portion of the quarry (i.e. Phase 3), because the elevation of the quarry floor will be either higher[39] or not much lower[40] than the river. The Board notes that the pit floor must be marginally lower than the river, if the area is to be reclaimed as a wetland.

[63] The Board notes that the quality of the water in the quarry lake will depend on the relative contributions of surface water and groundwater; and with respect to the latter, the relative contributions of fresher upper-unit groundwater versus the relatively high TDS lower-unit groundwater. The Board agrees with Birch Mountain that it is reasonable to anticipate that relatively fresh groundwater from the upper units will contribute disproportionately to the groundwater fraction of water filling the lake. Although the Board does not think it is possible to predict the eventual concentrations of water quality parameters with any precision, due to uncertainties about the relative contributions of the various sources of water, it notes that the previously discussed range of groundwater inputs (i.e. 5 - 24%) implies a four- to twenty-fold dilution with surface water, which should ensure an acceptable water quality.

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[37] The Board is of the view that the other two surface water scenarios are too extreme to be informative because the likelihood of experiencing historical minimum or maximum annual flows for one to several decades would be miniscule barring an abrupt change in climate.

[38] A small incremental effect could either be insignificant if the cumulative impact has not approached a critical threshold or significant if the combined effects of other disturbances have approached a critical threshold.

[39] Supplemental Information Response. Sept. 2004. p. 46.

[40] Supplemental Information Response. Sept. 2004. Figure AENV/NRCB 36.2 (c).

4.3 Surface Water Discharge

Views of the Applicant

[64] Birch Mountain stated that it did not plan to use water available onsite for purposes other than washing aggregate and controlling dust. Aggregate wash water would be collected in a settling pond and recycled. Potable water would be trucked to the site and sewage would be trucked offsite, alleviating the need for onsite treatment facilities.

[65] Birch Mountain stated that its quarry would be designed to minimize the contact of surface water with project components and activities. It stated that it would construct an interceptor ditch to the east and south of the quarry to divert natural runoff, which might otherwise enter the quarry, to the beaver pond to the southwest. Quarry water from seepage, runoff and precipitation would be pumped to a settling pond to the south of the quarry, and from there into the interceptor ditch. Other site-affected water, including water from collection ditches surrounding the truck facilities and rock and reclamation material stockpiles, would discharge into a separate settling pond to the east of the quarry. Birch Mountain stated that this settling pond would be pumped or gravity-drained to the south interceptor ditch.

[66] The surface water diversion system plan changed in November 2004,[41] to incorporate a fully gravity-drained ditch emptying into a single settling pond south of the quarry. The rock and reclamation material stockpiles, which were originally situated in the 'V-shaped wetland' and would have drained toward the east arm of the interceptor ditch, were moved inside the quarry. Seepage from these stockpiles would no longer drain toward the interceptor ditch.

[67] In April 2005, Birch Mountain again revised its plan, in order to improve fish habitat in the interceptor drainage channel.[42] In the most recent plan, Birch Mountain removed the second settling pond outside the quarry. Birch Mountain stated that if additional sedimentation control structures are added at the final design stage, they would be built to remove sediment before it entered the drainage channel or stream. Water captured in the drainage channel would flow directly into the beaver pond. Pit water would be recycled as aggregate wash water or used for dust control. Water in excess of the operating requirements would be collected in a sump in the floor of the pit, allowed to settle and then pumped into the drainage channel.

[68] Birch Mountain stated that it would calculate the concentrations of salts and metals at the point of discharge into the Muskeg River. It stated that it would ensure that water discharged from the project area would meet water quality guidelines for the protection of freshwater aquatic life or correspond to the water quality in the Muskeg River. Birch Mountain stated that it would establish a monitoring program at the point of discharge to the Muskeg River and immediately upstream.

[69] Birch Mountain presented water quality data collected by Syncrude, the Regional Aquatic Monitoring Program (RAMP) and the Water Survey of Canada at three sites on the Muskeg

[41] Second Supplemental Information Response. Nov. 2004. Figure 3, Conceptual Compensation Plan 'No Net Loss' Strategy for the Muskeg Valley Quarry, Appendix A.
[42] Conceptual Fish Habitat Enhancement Plan, dated March 15, 2005, forwarded to NRCB April 22, 2005.

River. It observed that the *Alberta Surface Water Quality Guidelines* for nitrogen and phosphorus and CCME guidelines for freshwater aquatic life were sometimes exceeded for aluminum, chromium, iron and zinc at the RAMP MUR-2 site upstream of the project.

Views of the Board

[70] The Board believes that Birch Mountain's plan to divert surface water around the mine has improved with each iteration. Initial concerns that the intercepted surface water could be contaminated with leachates from the rock and reclamation material stockpiles have largely been alleviated and the Board commends Birch Mountain for these improvements.

[71] The Board notes that only a single creek currently flows through the proposed quarry site: Unnamed Creek N, with its V-shaped wetland.[43] (Unnamed Creek S flows north toward the project boundary, but turns west to skirt the project's southern boundary.) Unnamed Creek N is variously shown to drain to the northwest toward the Muskeg River,[44] to the southwest toward the beaver dam,[45] and in both directions.[46] The Board understands that drainage may occur in both directions at times, due to the low relief of the terrain. It also understands that when the interceptor drainage channel is constructed in 2006, the creek will be diverted toward the beaver pond southwest of the quarry. The Board anticipates that the quality of water in the interceptor drainage channel will reflect the natural quality of Unnamed Creek N, now that the rock and reclamation material storages have been removed from the V-shaped wetland. The Board notes that the concentration of iron in Unnamed Creek N is a natural occurrence, not an impact of the project.

[72] The Board notes that Birch Mountain proposes to intermittently pump water from the pit into the drainage channel, when the amount of water in the pit exceeds the operational requirements for aggregate wash water and water for dust control. The Board understands that the pit dewatering stream would be kept separate from the aggregate wash water recycling stream. This separation of the two streams in the pit is a critical requirement in the Board's view, because solutes in the recycled pit water could concentrate through evaporation, potentially making that stream, or a mixture of the two streams, unsuitable for release into the environment. The only contaminants that should be found in the pit dewatering stream should be those found in the natural groundwater infiltrating into the quarry diluted to an unknown extent by precipitation.

[73] In the absence of predictions of the volume or quality of the water that would be pumped from the pit, the Board cannot determine whether pit dewatering would cause adverse effects to fish in Unnamed Creek N, salt-shock the downstream wetland, or result in an unacceptable release of metals and salts to the Muskeg River. Much depends on the relative contributions of precipitation, relatively good quality shallow groundwater and relatively poor quality deeper groundwater. In order to respond to this uncertainty, the Board will require as a condition that

[43] Supplemental Information Response. Sept. 2004. Figure SIR 6.4.1 and Table SIR 6.4.1.
[44] Application and Environmental Impact Assessment. March 2004. Figure 6.3.3, Natural Drainage Patterns.
[45] Second Supplemental Information Response. Nov. 2004. Figure 3, Conceptual Compensation Plan 'No Net Loss' Strategy for the Muskeg Valley Quarry.
[46] Second Supplemental Information Response. Nov. 2004. Figure 2, Baseline Habitat and Fisheries Inventory Map.

Birch Mountain measure the water quality in the sump and obtain permission from Alberta Environment before it releases pit water to the drainage channel.

[74] The Board generally agrees with Birch Mountain's stated objective of ensuring that water discharged from the project area will meet water quality guidelines for the protection of freshwater aquatic life or correspond to the water quality in the Muskeg River. To be clear, the Board interprets the second part of this objective to mean that the water quality of the discharged water would be no worse than the receiving water at the time of the discharge. Thus it would not be sufficient to demonstrate that, for example, a certain metal had once been observed at a higher concentration in the river than in the water leaving the project area. Otherwise, the objective would have little practical effect given the number of parameters that sometimes exceed guidelines in the Muskeg River. The Board notes that in addition to the selected metal parameters highlighted by Birch Mountain (aluminum, chromium, iron and zinc), cadmium, silver and possibly arsenic also sometimes exceed CCME water quality guidelines for freshwater aquatic life.[47]

[75] The Board foresees that two exceptions to Birch Mountain's objective may be necessary. The first would apply if the pre-impact concentration of a metal in water discharged from the project area naturally exceeded its concentration in the river. This would be true of iron, which was measured at three times the CCME guideline in Unnamed Creek S near the beaver dam. If this pattern is consistent in subsequent sampling, it would not be possible for Birch Mountain to meet its stated objective because the natural concentration of this metal on site exceeds both the guideline and the concentration found in the river. A better objective for any parameter, such as iron, that is naturally greater in the surface drainage from the area than in the river, would be to ensure that the project does not elevate the parameter in the discharge water over the pre-impact concentration. The Board is optimistic that this lesser objective can be achieved, even though the iron concentration in the groundwater that would contribute to the water pumped from the pit is two orders of magnitude above the CCME level.[48] Much of the dissolved iron in the groundwater should oxidize and drop out of solution in the in-pit settling pond, if it is properly managed, making it quite feasible to separate the precipitated metal from the pit dewatering stream.

[76] A second exception to Birch Mountain's objective could be needed for salt. The Board notes that sodium and chloride concentrations are an order of magnitude greater than their respective guidelines in the groundwater from the lower limestone strata,[49] whereas both concentrations in the Muskeg River are consistently below the guidelines.[50] The Board recommends that Alberta Environment address these two exceptions in its *AEPEA* approval.

[77] Birch Mountain stated that it would calculate the concentrations of salts and metals at the point of discharge into the Muskeg River from measurements of chemical parameters at the

[47] Application and Environmental Impact Assessment. March 2004. The Mur-2 site table, Appendix I lists an arsenic value of 41µg/L for the spring of 2001, yet the maximum observed concentration is listed as less than 5 µg/L. The CCME guideline for arsenic is 5 µg/L.
[48] Application and Environmental Impact Assessment. March 2004. Table 6.2.2, Groundwater Quality in the Birch Mountain Muskeg Valley Quarry Area.
[49] Ibid.
[50] Application and Environmental Impact Assessment. March 2004. Appendix I.

settling pond(s). The Board believes this would be difficult because the prediction would include many variables that are subject to change or difficult to measure (i.e. the relative volumes of water and concentrations of metals and salts in unnamed creeks N and S, the beaver pond and sources of groundwater upwelling). Birch Mountain shall, to the satisfaction of Alberta Environment, establish criteria for the release of sump water. Birch Mountain shall provide water quality data to and obtain permission from Alberta Environment prior to any release.

[78] The Board accepts Birch Mountain's proposal to monitor at the point of discharge and immediately upstream, in order to measure the discharge water quality. Monitoring should begin before the pit water is pumped into the interceptor ditch and should continue until the affected water has completely discharged into the river.

[79] Finally, the Board notes that some of the leachate from waste rock and reclamation material stockpiles under the revised mining plan would drain into the pit and be removed during pit dewatering. It appears from the revised plan that the remainder could seep into adjacent natural vegetation or wetlands. The Board recommends that Birch Mountain work with Alberta Environment, once operations have commenced, to assess the need to construct interceptor ditching to contain the leachate.

4.4 Soils, Vegetation and Reclamation

4.4.1 Soils and Reclamation

Views of the Applicant

[80] Birch Mountain conducted a 2003 soil survey primarily by aerial photo interpretation and use of information from existing maps, supplemented by field checking at 10 sites. Data were collected at 92 additional sites in 2004, resulting in a survey intensity of 1 site per 3 ha to satisfy the survey intensity level requirements. The soils and terrain impact assessment, as presented in the supplemental information update, reflects the data collected in both 2003 and 2004.

[81] Birch Mountain identified the main issues for the environmental assessment on soils and terrain to be impacts to 'topsoil' and muskeg quality (including soils suitable for reclamation) and quantity, loss of soil systems, impacts on soil capability for forestry in non-quarry areas, and impacts to any unique soil and terrain units that may exist within the Local Study Area (LSA).

[82] The suitability of soils for reclamation was determined through application of the criteria for the Northern Forest Region as outlined by the Alberta Soils Advisory Committee (1987), and forest capability was assessed based on an accepted rating system. Susceptibility of the soils to wind and water erosion was also evaluated.

[83] Birch Mountain provided a baseline terrain map of the LSA and updated it using detailed field survey data, collected in June 2004. A descriptive summary and the land areas of the various terrain units were presented.[51] Upland glaciofluvial veneer and blanket sediments

[51] Supplemental Information Response. Sept. 2004. Table SIR 5.3.4, p. 5-10.

overlying bedrock, characterize the predominant terrain of the LSA. Glaciofluvial deposits account for 408 ha of the LSA. Topography is undulating to hummocky. The remaining undisturbed lands are characterized as either shallow fen (140 ha) or shallow bog (56 ha) overlying glaciofluvial sands and bedrock. Disturbed lands cover 21 ha of the LSA and open water accounts for 6 ha.

[84] Birch Mountain provided a baseline map of the soil resource in the LSA, indicating the distribution of dominant soil series or variants. The areal extent of these soils, as well as interpreted soil attributes, were summarized and presented on a map unit basis.[52] The Mildred soil series (Brunisolic Order) account for 122 ha of the LSA. Brunisolic soils exhibit a poorly developed soil profile. The Fort soil series (Luvisolic Order) account for 223 ha of the LSA. Luvisols are a characteristic soil of forested regions. 196 ha of the LSA are covered by Organic soils (Hartley and Mariana soil series). These soils are associated with the bog and fen areas of the LSA. The Bitumount soil series (Gleysolic Order) cover 63 ha of the LSA. Gleysols are soils developed under conditions of water saturation. Disturbed soils account for 21 ha of the LSA and 6 ha are covered by open water.

[85] The primary impacts to soils and terrain would result from limestone extraction and associated activities such as site clearing, soil lift and salvage, grading and contouring, overburden and waste material storage, and road construction and traffic. Loss of soils, admixing of soil layers (decreasing soil quality), compaction, erosion, contamination, and changes in soil moisture conditions due to changes in the local water table and drainage patterns could also occur. Decreased soil quality resulting from these impacts would in turn impact the suitability of soils for reclamation, as well as their capability for forestry.

[86] Birch Mountain explained that there were specific salvage and storage considerations for mineral versus organic soils. General mitigation strategies included minimizing surface disturbance, preservation of the original soil quality, amelioration of soil compaction prior to reclamation, implementation of erosion and drainage controls, and the prevention or treatment of soil contamination. Some specific means of accomplishing these goals were described. All soil salvage stockpiles would be located within the disturbance area for the three mining phases.

[87] Birch Mountain stated that the total volume required to cap the various areas to be reclaimed was approximately half the volume that would be salvaged, and that the excess organic and mineral soils would be reclaimed in place (i.e. the salvage storage pile). Most of the excavated subsoil would be used to backfill the quarry lake, as well as placed at a depth of 70 cm on the waste rock storage area and the areas of the quarry to be reclaimed to upland vegetation, prior to a topsoil layer of 15 to 30 cm depth being replaced evenly on all disturbed surfaces. Most of the salvaged topsoil would be reclaimed in place, as Birch Mountain indicated that only about a third of the volume salvaged would be replaced during reclamation.

[88] Birch Mountain stated that one reason for the salvaged topsoil volume exceeding the reclamation requirement was the large area covered by the quarry lake. Birch Mountain suggested that the balance of materials could be used by other projects. Birch Mountain acknowledged that deeper topsoil profiles than proposed in its conceptual reclamation plan may

[52] Supplemental Information Response. Sept. 2004. Table SIR 5.3.3, p. 5-9.

be beneficial for forest growth; however, committing to creating a deeper topsoil depth would limit potential future management options. Birch Mountain maintained that reclaiming surplus soil in place provided the best balance between preservation and resource use, with flexibility for future planning.

[89] A key component of Birch Mountain's organic soil salvage plan was an approximate over-stripping of 25% by volume, which would include what would normally be referred to as subsoil. The mixing that would occur as a result would, in Birch Mountain's view, create a more suitable growing medium than either the peaty surface soil or sandy subsoil stripped separately. Designation of the subsoil (glaciofluvial sands over bedrock) beneath the organic soils was rated as "fair" for reclamation suitability, based on the decision to mix the organic materials with the sandy subsoils, improving their moisture and nutrient-holding capacity. The balance of the subsoil below this upper lift was rated as poor for reclamation suitability, and Birch Mountain indicated that it planned to salvage and store this soil separately.

[90] Birch Mountain stated that any bitumen-saturated sands excavated, that could not be transported and processed by oil sands operators, would be stored in the waste rock area and covered with a minimum of 1 m of overburden/topsoil during reclamation. If bituminous limestone was encountered in quarrying, Birch Mountain stated that it would work with local asphalt producers and regulators to establish its potential use as an asphalt concrete for road surfacing. Also, if the chemical properties indicated a quality suitable for calcining, the material could be used in the kilns for the proposed Hammerstone project, reducing external fuel source requirements to operate those kilns. If, however, limestone containing bitumen were to be stored for any period of time, Birch Mountain stated that it would separate the bitumen-containing materials, capture and manage runoff from the storage area, and reclaim stored materials, if necessary, as per procedures described for other quarry areas.

[91] In the supplemental information, Birch Mountain responded to concerns that bitumen saturated limestone exposed during the mining process might release high concentrations of napthenic acids into the surface environment. Birch Mountain acknowledged that bitumen was distributed along fractures in the quarry wall rock and was present at trace concentrations in all units of the Moberly member at the Muskeg Valley Quarry. Occurrence in higher concentrations was restricted to an area of limited extent within the northern part of the quarry area, and within fractures and pores of the middle quarry unit where the average estimated content was 0.45% by weight. Birch Mountain stated that there was no mechanism to prevent lake water from coming into contact with rock containing trace levels of bitumen. Higher levels of bitumen in the middle quarry unit would be isolated from lake water by burial beneath waste materials of low grade shaley limestones containing only trace bitumen. Birch Mountain likened this situation to the pre-disturbance state. Birch Mountain stated that because it would not be processing rock in elevated pH or temperature conditions, it was unlikely that napthenic acid concentrations of greater than 1 mg/L would be generated by contact of quarry lake waters with bituminous waters. Birch Mountain cited the current natural water quality in the region as support for this hypothesis.

[92] In its conceptual conservation and reclamation plan, Birch Mountain explained that progressive reclamation was planned for the three phase mining process, although there would be limited opportunity for progressive reclamation of areas that would be re-vegetated permanently during the first several years, because the quarry lake would occupy most of Phases 1 and 2. Final reclamation of Phase 3 was expected to take two years following the completion of mining. Birch Mountain noted that the end land use would be substantially different from the pre-disturbance condition, given that a large percentage of the disturbance area would become a lake suitable for recreational purposes. Birch Mountain indicated that reclamation objectives included commercial forest production, wildlife production, and limited recreational opportunities. Overall the land capability for forestry in the reclaimed landscape was expected to improve compared to the pre-disturbance forestry capability.

[93] Birch Mountain explained that there were three key factors involved in determining the final end land use for the quarry. These were: overlapping lease holds between Birch Mountain and Shell Canada Limited and the need to meet interests of both lease holders; integrated land use planning, as a result of the significant regional development (e.g. the potential need to use the quarry as fish habitat compensation by developers other than Birch Mountain); and, Birch Mountain's ability to plan and operate the quarry project, including obtaining regulatory approval. Birch Mountain was of the view that a final decision regarding land use did not need to be made until the very late stages of quarry development (~ 30 years) although an earlier decision would assist Birch Mountain in applying progressive reclamation and returning the development area to a natural state.

Views of the Board

[94] The Board understands that Birch Mountain has used generally accepted practices for guidance in developing its conceptual reclamation plan, and that due to the long lifetime of the active quarry, any detailed reclamation planning performed at this time will likely need to be revised as new techniques are developed and research generates revised best practices. The Board is concerned with the uncertainty related to the reclamation plan, but believes that the uncertainty may be resolved through commitments described later in this section.

[95] The stability or maintenance of quality of the stockpiled organic soil over long periods of time under different moisture conditions is unknown. Related to this issue is the planned use of only half of all stockpiled materials, and one third of the 'topsoil' mixture created during soil salvage. The Board believes Birch Mountain could improve its chances of reclamation success by planning additional topsoil spreading.

[96] It is clear to the Board that Birch Mountain has accounted for land capability for forestry and for recreation in its reclamation objectives; however, end land use goals oriented toward ecological restoration and sustainability are less clear. It is understood, however, that the success of re-vegetation programs and resulting wildlife habitat established hinges on the successful salvage and restoration of the soil. The Board also recognizes that the final landscape after reclamation would be considerably different from the existing landscape in terms of the soils, terrain, vegetation composition, and wildlife species supported.

[97] The Board acknowledges the role of Alberta Environment in determining detailed reclamation requirements through the *Alberta Environmental Protection and Enhancement Act* (*AEPEA*) approval process, and recognizes that the typical ten year *AEPEA* approval renewal timeframe required for these projects could incorporate current reclamation practices as research progresses. Nonetheless, the Board believes it would reduce the uncertainty associated with reclamation planning and its success, if Birch Mountain re-evaluated its reclamation planning at five year intervals. In addition, the Board recommends that the following reclamation principles should be incorporated into the reclamation plan presented to Alberta Environment. The reclamation plan should:

- account for the ability of the reclaimed landscape to support pre-disturbance vegetation and wildlife in a measurable way;
- identify practices such as the thickness at which to spread surface soil layers to maximize reclamation success and principles of soil conservation; and,
- report changes to the pre-disturbance ecological landscape.

4.4.2 Vegetation

Views of the Applicant

[98] Birch Mountain used data from recent EIAs in the region, purchased datasets, literature, and field surveys during the summer of 2003 to complete the vegetation portion of its EIA. One rare plant survey was conducted in July 2003, and additional vegetation and rare plant surveys were conducted in the spring and summer of 2004.

[99] Birch Mountain identified the LSA of the proposed project as a 631 ha area. Eighteen ecosite phases were identified in this LSA, of which 367 ha were uplands and 237 ha were lowlands. Approximately 42% or 266 ha of the LSA were identified as wetlands by the Alberta Wetland Inventory (AWI).

[100] The project footprint identified in the original application was 255 ha of the LSA. Impacts to most ecosite phase types within the LSA were expected to occur due to physical disturbance. Settling dust resulting from mining activity could also impact vegetation within 30 m of the quarry disturbance area and roads. Birch Mountain indicated that reclamation would eventually reduce or reverse impacts for some ecosite phases, mainly the upland ecosite types.

[101] All wetland types found within the LSA were expected to be impacted due to removal of 112 ha of wetland vegetation, although with the revised access road routing, the impact was expected to be slightly less. The applicant explained that successful reclamation of wetlands was dependent on the ability to re-establish hydrological conditions to support wetland communities. Reclamation of marshes would be possible around the margins of the planned lake; however, the feasibility of re-establishing bogs, fens, and swamps was described as uncertain. The applicant also stated that drawdown of water in the LSA could affect fens due to their unique hydrologic flow requirements, and permanent wetland loss could occur as a result. Birch Mountain stated that these wetlands would likely be replaced by a shrub community in the intermediate term, as part of the typical ecological succession processes of the region.

[102] Changes to rare plant potential were expected to occur with the planned development, and a number of rare plants and rare plant communities were predicted to have the potential to occur within the Muskeg Valley Quarry LSA, based on their occurrence in similar ecosites elsewhere and known habitat requirements. Assuming vegetation re-establishment at the end of reclamation, an overall increase in areas with low rare plant potential and decrease in areas of medium and high rare plant potential was expected. From rare plant surveys conducted in 2004, 1 provincially listed rare species was observed at 2 locations, based on surveys conducted at 22 target areas. The post-reclamation landscape was expected to provide suitable habitat for the rare plant species observed, although no specific mitigation for this rare species was proposed. Ecosites were also classified according to their relative predicted plant diversity, with overall decreases in areas of high, medium, and low plant diversity expected due to the disturbance area.

[103] Birch Mountain stated that re-vegetation of upland areas would focus on establishing forested communities similar to those currently in the area. Reforestation would not occur in low lying depressions (i.e. wetlands), where conditions are not conducive to commercially productive tree growth. In all areas, annual species such as barley or ryegrass would be applied in the first year to provide initial erosion protection. Birch Mountain stated that the general reforestation approach would reintroduce dominant over-storey species and, in some instances, some of the characteristic under-storey (i.e. shrub) species. The target ecosite phases for reclamation would be an upland dominated forest ecosystem consisting of five ecosite phase types as well as the end-quarry lake.

[104] Birch Mountain indicated that re-vegetated areas would be monitored at regular intervals during the first three years, to ensure that re-vegetation proceeded as planned. All areas would be inspected regularly to determine the presence of restricted and noxious weeds, so that appropriate measures can be taken for their control. The applicant noted in its November 2004 supplemental submission that it was expected to take much longer than five years, however, for the reclaimed landscape to develop into the defined ecological units similar to the pre-disturbance ecosite phases.

Views of the Board

[105] While the original number of ecosites described for the LSA in the application was 18, several of which were represented in the disturbance area, the Board finds that only 5 are represented on the reclaimed landscape, and their distribution is significantly different from the original landscape. In comparison to the 7 wetland types distributed throughout the undisturbed landscape, the Board finds a large wetland is expected to form on the post-reclamation landscape on the west side of the quarry, and the large quarry lake, as described in the reclamation plan, would contain some marsh habitat at the lake margins similar to a pre-disturbance wetland type. The Board notes that the focus of the revegetation component of the reclamation plan is on establishing merchantable timber. While this focus has merit from one land use perspective and is likely to result in habitat suitable for some plant and wildlife species and communities, particularly after long-term natural ecological processes are allowed to occur, the Board notes that the proposed reclamation plan does not directly address the loss of vegetation species and communities and changes to the soil and hydrologic regime in the original pre-disturbance

landscape. In evaluating the significance of the impacts from the proposed project, the Board finds these factors are important to consider because of their implications for changes to biodiversity, ecosystem function, and the pattern of succession that follows.

[106] The Board notes that the reclamation plan, as described, is consistent with planned reclamation for other regional projects, and reflects objectives as identified in the *Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region*, published by Alberta Environment in 1998. The reclamation plan does not, however, discuss potential alternatives for restoring wetlands as per the *Guideline for Wetland Establishment on Reclaimed Oil Sands Leases*, nor does it explain proposed monitoring after the reclaimed landscape has been established to determine accuracy of EIA predictions and success of mitigation toward re-establishing pre-disturbance plant and wildlife species and communities. The first ten years of monitoring during operations are described; however, it is unclear what commitments exist for the remainder of the mine's lifetime. The Board recommends that Alberta Environment establish clear commitments from Birch Mountain to monitor beyond this timeframe.

[107] The Board recognizes that, relative to other projects in the region, Birch Mountain's proposed project would result in a small disturbance. It is reasonable to assume that, since the ecosites, species, and even rare species found in the LSA are found elsewhere in the boreal mixed wood ecological region, even if these natural elements were lost locally due to the project disturbance, they would not cease to exist entirely. However, without understanding whether the proposed project area is representative of the remaining undisturbed regional landscape, and without detailed inventories of species and communities for the various ecosites, it is difficult to predict the implications for future projects in the absence of a regional decision-making threshold.

[108] Nonetheless, the Board believes these potential risks can be mitigated through detailed reclamation planning and monitoring, as well as a more closely documented assessment of resources being removed and the potential for their re-establishment (i.e. rare plant surveys in additional locations as they become accessible via disturbance, rare plant mitigation strategies, examination of impacts to vegetation regionally, impacts to wildlife habitat regionally as a result of vegetation loss or changes in patch size and distribution, success of reclamation measures, innovation with respect to attempted wetland restoration, and monitoring actual versus predicted results of reclamation).

[109] The Board is aware that both common and rare species associated with wetlands provide genetic diversity which facilitate resilience of an ecosystem to disturbances and disease, can be significant to traditional ways of life, can offer potential services to humans beyond their current uses (e.g. pharmaceuticals), and collectively provide ecosystem functions that in some cases are not well understood, or have broader implications than that of a local disturbance (e.g. water 'purification'). For these reasons, the Board takes the disturbance of an additional 255 ha of land in the already highly developed northeast boreal forest region of Alberta, and the associated loss and/or changes to vegetation and ecosites seriously. It therefore recommends that Alberta Environment consider incorporating more proactive opportunities for wetland re-establishment, and require reclamation timing and post-reclamation monitoring to examine the success of the proposed strategies and accuracy of EIA predictions. The Board requires as a condition of its

approval that Birch Mountain must revisit its reclamation plan every five years, rather than every ten years, to incorporate the most up to date research regarding reclamation, revegetation, and rare plant mitigation for the region to the satisfaction of Alberta Environment.

4.5 Wildlife and Fisheries

4.5.1 Wildlife

Views of the Applicant

[110] In the original application, existing field data collected for EIAs for nearby oil sands projects were evaluated to determine the potential impacts on wildlife in the quarry study area. The key wildlife species examined for the purposes of the Muskeg Valley Quarry EIA were moose, Pileated Woodpecker, Canadian Toad, and the Northern Long-eared Bat. Original assessments specific to this EIA included a bat survey and Habitat Suitability Index (HSI) modelling for the key species.

[111] For moose, an important prey species for large carnivores and important for recreational hunting and First Nations subsistence, HSI modelling indicated that 108 ha of suitable habitat would be affected by the project, including 28 ha of high quality habitat out of the 96 ha of high quality habitat identified in the LSA. Birch Mountain stated that moose may be most affected by hunting adjacent to new corridors, increased predation rates, and accidental vehicle collisions along roadways. Noise could disrupt movement patterns of moose within 100-500 m of the disturbance area, but it was expected that moose would adjust movement patterns around the quarry by using the Muskeg River riparian area. Truck traffic on the Canterra Road was expected to permanently affect moose habitat.

[112] Out of 350 ha of moderate or better quality Pileated Woodpecker habitat, the HSI showed that 126 ha would be removed, 69 ha of which is high quality habitat. While Pileated Woodpeckers are considered a sensitive[53] species in Alberta, woodpeckers are not generally expected to be limited by human activity. Mortality from disturbance of nest sites was possible, and decreased habitat would translate into decreased foraging and nesting resources. Birch Mountain reported an average Pileated Woodpecker territory in Alberta to be about 2000 ha, and that the quarry could only affect a small portion of that range.

[113] The Canadian Toad, listed as “May be at Risk”[54] in Alberta, is thought to have 534 ha of suitable over-wintering habitat and 461 ha of suitable foraging habitat in the LSA, based on two separate HSI models for winter and summer habitat requirements. The proposed project would

[53] Sensitive species: Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk (from the General Status of Alberta Wild Species 2000, Alberta Sustainable Resource Development).

[54] May be at Risk species: Any species that "May be at Risk" of extinction or extirpation, and is therefore a candidate for detailed risk assessment (from the General Status of Alberta Wild Species 2000, Alberta Sustainable Resource Development).

remove 201 ha of breeding habitat in drainages and fens, and about 217 ha of over-wintering habitat. Loud noise could disrupt breeding behaviour of the Canadian Toad; however, there are no known breeding populations of this toad in the vicinity of the quarry. Where populations exist, breeding populations can be isolated from one another by barriers to movement, and vehicle collisions during migrations can be a significant source of mortality for amphibians generally. Mortality can also be caused by the direct disturbance of hibernating toads.

[114] It was identified that 369 ha of the available habitat for Northern Long-eared Bats, described as "May be at Risk"[2] in Alberta, were found to be of moderate or better quality in the LSA. HSI modelling results predicted that 136 ha of suitable habitat was predicted to be affected in the HSI modelling results. Birch Mountain stated that habitat that provides roosting sites (especially for maternity colonies) was likely not as abundant as predicted by the HSI model. Foraging habitat along the Muskeg River would not be disturbed due to the 200 m buffer along the river that Birch Mountain committed to leaving undisturbed. Movement of bats would not likely be affected, and while bats are known to use linear corridors and clearings, there is little information regarding how sensory disturbance (truck and machinery traffic) might impact them. Habitat use by bats and over-wintering in the LSA was not well understood. Birch Mountain stated that relative to regional habitat availability, impacts on bats would be small.

[115] The more extensive August 2004 bat survey resulted in recovery and detection of bats at a level well exceeding the single night survey conducted in 2003. Bats were reported to occur in the project area in relatively high numbers, however, the highest numbers were not recorded within the proposed project footprint. Birch Mountain predicted that the impact after habitat and mitigation measures were implemented would still be low.

[116] Other wildlife species likely found in the LSA or reported in similar habitat elsewhere include various ungulate species, large carnivores, various terrestrial furbearers and semi-aquatic mammals, other small mammals, owls, raptors, upland gamebirds, waterfowl, additional woodpecker species, passerines, and reptiles and amphibians. Several of the species in these groups have special status in Alberta, and some are economically important in the region (e.g. lynx). Impacts to these species would primarily be related to habitat disturbance, however specific impacts for a number of species were not fully understood (e.g. reaction distances of furbearers to disturbance, lynx habitat avoidance, emissions and dust effects on wildlife generally). Some impacts may be indirect, for example through reduced nutritional value of plant forage. Many species were expected to habituate to noise, but others (e.g. raptors) have a higher sensitivity to human disturbance, especially during breeding season.

[117] Birch Mountain reported that field surveys conducted to date included winter track counts, owl call playback surveys, amphibian surveys, browse and pellet group counts, snake surveys, songbird point counts, and northern goshawk call playback surveys. A bat survey and second snake survey were also conducted in August and September 2004. Surveys were conducted in the LSA and a "south monitoring area," which was established to support a wildlife monitoring program scheduled to occur during construction and operation of the proposed project. Birch Mountain concluded that generally speaking, the results of the survey work supported the impact predictions in the original EIA.

[118] In response to questions in the Supplemental Information Request, Birch Mountain reported that uncertainties in ecosite phase mapping and HSI modelling could be reduced with ground surveys to confirm vegetation communities and species presence. These surveys were conducted in 2004, and data remained to be evaluated at that time in the context of their use in the Pileated Woodpecker model.

[119] An addendum to the original application was provided in September 2004 to update the EIA findings based on a revised access road location proposed in order to avoid a significant archaeological resource found on the LSA. Birch Mountain stated that the proposed new road route would not pass through any habitat considered critical for the four key species evaluated in the EIA. In fact, high and good quality habitats for moose, Pileated Woodpecker, Northern Long-eared Bat, and winter habitat for the Canadian Toad were slightly less affected by the new road routing than by the original plan. High and good quality summer Canadian Toad habitat would decrease by 1 ha each with the new road alignment. Effects of the new road route on songbird diversity were not expected to increase compared to the original route.

[120] Birch Mountain committed to a number of mitigation and habitat enhancement measures in its application, including maintenance of a minimum 200 m buffer between the quarry and the Muskeg River to protect movement corridors for large mammals and potential habitat for amphibians and other species. In addition, it coordinated clearing with Alberta-Pacific Forrest Industries Inc. (AlPac) to minimize impacts on migratory birds, implemented various measures to control access and the risk of vehicle collisions with wildlife, and agreed to the cessation of clearing and construction activities upon encountering a den or raptor nest site until Fish and Wildlife officials were consulted. Included in the second Supplemental Information Request response was a report that 13 wildlife enhancement structures had already been installed: 2 raptor nesting platforms, 5 owl next boxes, and 3 small and 3 large roosting boxes for bats. Despite these proactive measures at maintaining and restoring habitat for some wildlife, Birch Mountain explained that many of the wildlife species and vegetation communities currently supported by the various ecosite phases would not be supported to the same extent in the first five years or likely for many years following reclamation.

Views of the Board

[121] The Board recognizes that Birch Mountain conducted a number of wildlife field surveys and drew from a regional body of data in presenting predicted impacts of the project on various wildlife species. The Board also notes that a number of commitments related to ongoing monitoring and follow-up to EIA predictions were made in the application, and believes the results of that work will be important for verifying the predictions of the EIA.

[122] As in the case of potential impacts to vegetation, the Board finds it is reasonable to assume that because Birch Mountain's proposed project is relatively small compared to other regional projects, the impacts to wildlife species will also be relatively small. However, the Board notes that considerable disturbance to wildlife habitat is occurring or is expected to occur in the region as a whole, and therefore impacts to some species may be significant. The wildlife mitigation measures proposed are likely to improve the opportunities for wildlife to survive and/or re-establish within reclaimed landscapes, however, due to the changed nature of the

landscape post-reclamation, and due to the uncertainty of cumulative effects on wildlife in the long term, the Board believes that the results of the monitoring and wildlife enhancement programs proposed are particularly important.

[123] The Board finds that the Cumulative Environmental Management Association and regional monitoring-oriented groups (e.g. Regional Aquatic Monitoring Program) cited in the application are certainly of importance in establishing long-term management strategies and recommendations for the region with respect to development and its associated impacts on wildlife. However, the Board believes this does not absolve Birch Mountain from its own distinct responsibility toward monitoring and follow-up regarding EIA predictions, and requires that Birch Mountain adhere to its commitments independently. Such post-construction evaluation is particularly important, given the uncertainty with respect to HSI modelling and the lack of species specific information for certain wildlife, including species of concern (e.g. tolerance to disturbance as it affects reproduction).

[124] Finally, the Board notes that the proposed reclamation landscape, while suitable for a number of species, would be significantly changed (i.e. in terms of the proportion and distribution of uplands compared to wetlands) and that the vegetation composition would be simplified, at least for a number of years and possibly decades following re-vegetation. The Board therefore believes that establishing clear timing of reclamation and post-reclamation monitoring will be particularly important for ensuring minimal long-term effects on wildlife species. The Board expects full compliance with all commitments made by Birch Mountain with regard to wildlife enhancement and future monitoring.

4.5.2 Fisheries and Aquatic Resources

Views of the Applicant

[125] Birch Mountain concluded in its initial application that there was a very low potential for direct loss or alteration of fish habitat, as it believed at that time that there were no fish-bearing waterbodies in the project area. It described four reaches of the Muskeg River just upstream or downstream from the proposed project and the fish species that had been captured in the Muskeg River watershed during other studies. Birch Mountain explained that fish habitat and inventories in the westward draining tributaries would be investigated in 2004 to confirm whether they supported fish.

[126] Birch Mountain stated that the 200 m setback of the edge of the quarry from the river would protect fish habitat in the Muskeg River. The setback would protect riparian vegetation and maintain important habitat features adjacent to and influencing the river. Birch Mountain concluded that although wetlands would be removed by construction and operation of the proposed quarry, fish habitat would not be affected because the existing streams and wetlands were too small, shallow, or ephemeral to support fish.

[127] Birch Mountain concluded that development of the quarry would not change water flows or flow patterns in the Muskeg River, although changes in water quality would be possible due to sediment loading, discharge of infiltrated pit quarry water and deposition of air emissions to

water bodies. These potential effects would be mitigated through the use of diversion ditches to minimize the amount of surface water coming into contact with quarry activities and minerals, using water containing elevated levels of sediment for dust control, and using settling ponds to remove suspended sediment prior to release into channels discharging to the Muskeg River. Birch Mountain also planned to establish a program to measure TSS levels in the Muskeg River to ensure that TSS levels remain below the 10 mg/L threshold recommended by CCME guidelines. Birch Mountain stated that monthly sampling would occur upstream and downstream of the quarry and in all settling pond outflows (although as described in the updates to the application, settling ponds no longer have direct outflows connecting to the river).

[128] Birch Mountain described that during quarrying, water entering the pit would primarily be groundwater, which would likely be saline, have a high dissolved solids concentration, and high concentrations of aluminum, copper, iron, and selenium. Despite this, the volume of water from the pit expected to come into contact with the Muskeg River by either infiltration on discharge would be very low and would thus be diluted by the Muskeg River water volume. Nonetheless, Birch Mountain indicated that it would establish a program to monitor the quantity and quality of quarry pit water, surface water runoff, and the Muskeg River.

[129] Birch Mountain indicated that due to mitigation of dust emissions and low acidifying emissions generated by the project, there would be no impact to fish health or habitat due to air emissions and their impact on water quality. Birch Mountain believed that since flocculants would only be used in the wash-water recycling system, none would enter streams or water bodies in the LSA or Muskeg River. Surplus wash water would be used to water roads to reduce the dust generated.

[130] Birch Mountain also stated that blasting at the quarry was not expected to have any impact on fish species in the Muskeg River, as the 200 m setback distance between the quarry and the Muskeg River was greater than the recommended guidelines for setbacks where confined explosives are used near fisheries waters.

[131] Birch Mountain acknowledged that the ability of the ‘clearwater quarry lake’ to support fish depended largely on its final water quality, and indicated that during final reclamation, diversion ditches would be removed and the new drainage network would be largely filled by surface water. This process is further described in the surface and groundwater sections of the application.

[132] A survey was conducted in May 2004 to verify the existence of streams and waterbodies, to correct any aerial photo misinterpretation and to identify homogenous stream habitat and sample sites. Habitat assessments were then conducted at eight sites. Fish sampling was only possible at four of the eight sites. Birch Mountain concluded that while there would be a minor direct loss and alteration of fish habitat within the V-shaped wetland and small outlet stream, the quarry would not have a major impact on fish in the LSA or in the Muskeg River.

[133] Fisheries study sites established in the spring of 2004 were revisited in September to assess resources during low flows. All locations surveyed were found to have much lower surface flow volume, and the V-shaped wetland was found to be dry, however, the catch per unit

effort was found to be higher in the fall than in the spring surveys. This did not result in changes to EIA predictions for fish; however, the federal Department of Fisheries and Oceans (DFO) requested the preparation of a fisheries habitat compensation strategy and a "No Net Loss Plan." The requested documents were submitted to DFO in November of 2004, and a copy was provided with the response to the second SIR. Authorization by DFO under Section 35(2) of the *Fisheries Act* is pending. Birch Mountain provided a conceptual fish habitat enhancement plan to DFO in March 2005 and provided a copy of that document to the Board in April.

Views of the Board

[134] With respect to impacts on fisheries in the study area, the Board sought input from DFO. In February 2005, DFO clarified for the Board that a *Fisheries Act* authorization was required for the proposed project and was pending, however, DFO stated it was confident that losses to fish habitat could be compensated. For this reason, the Board is assured that Birch Mountain is addressing the fisheries issues associated with the project. The Board is aware that successful restoration of fish habitat is dependent on a number of factors, including the water quality of the quarry lake. The Board is also aware of the challenges regarding the prevention of potential contamination of surface waters on the reclaimed landscape especially involving residual flocculants used in settling ponds or exposed bitumen limestone. While the Board acknowledges Birch Mountain's assurance that the dilution that would occur in the quarry lake or the Muskeg River would reduce potentially harmful substances to minute quantities, the Board nonetheless strongly supports Birch Mountain's commitments to monitor water quality to ensure that surface water quality does not result in an unacceptable impact to fish and aquatic habitat.

4.6 Cumulative Effects

Views of the Applicant

[135] Birch Mountain noted that among the activities in the region surrounding the Muskeg Valley Quarry project are timber harvest, seismic exploration, oil and gas production, mining, off-road vehicle use, hunting and trapping. Birch Mountain emphasized that its mine project would be small in relation to the very large scale of development and disturbance in the region. It stated that the Muskeg Valley Quarry project area represents about 5 km^2 or 0.3% of the 1483 km^2 Muskeg watershed, while existing or proposed oil sands projects occupy 87.8% of the watershed.

[136] Birch Mountain stated that its project would not contribute to cumulative effects on soils, groundwater, hydrology and water quality in the Muskeg River, vegetation, wildlife, and fish populations, because the residual effects of the mine would be negligible or insignificant when viewed from a regional perspective. It stated that there would be no cumulative effect of noise, because there is no other nearby source of noise to combine with the project's noise. Birch Mountain stated that its project would contribute to the total concentration of fine particulate matter ($PM_{2.5}$), but stated that even under the worst assumptions (quarry at 2.5 m below ground level; no emission mitigation), total $PM_{2.5}$ would be well below the CWS. This statement was

later corrected when revised estimates of cumulative concentrations prepared in response to supplementary questions produced values approaching or exceeding the CWS.[55]

Views of the Board

[137] The Board understands that the Muskeg Valley Quarry project is located in a region undergoing disturbance on an unprecedented scale. By comparison with the major oil sands projects, the scale of disturbance due to this project will be small. Nevertheless, the project calls for disturbance of 255 ha of land, which would not be insignificant by normal standards. The purpose of a project-centred cumulative effects assessment is to determine whether the combined effects of the project, and existing and foreseeable projects and activities will cumulatively result in effects that should be avoided, if possible.

[138] The Board agrees with the applicant's assessment that the potential for interaction with the effects of other projects and activities may be reduced or even eliminated by successfully mitigating many of the project's potential adverse effects. The Board commends Birch Mountain for the significant improvements it has made since the submission of its March 2004 EIA to mitigate the project's potential impacts on surface water quality and fish populations.

[139] The Board accepts that any mining project entails a class of impacts that cannot be avoided or significantly mitigated, except to reclaim the site and establish the foundation for a natural community when the mine closes. Approval of the Muskeg Valley Quarry will entail the loss of vegetation and the loss, fragmentation and alienation of animal habitat. These impacts will combine with the effects of other projects and activities in the region and may threaten the local extirpation of animal species. The Board agrees with the applicant that the thresholds beyond which species will be unable to persist are presently difficult to assess, although it expects that data on this subject will be forthcoming as the level of disturbance in the region approaches and exceeds those thresholds. For that reason, the Board believes it is imperative that Birch Mountain work with regional industry and stakeholders to monitor wildlife during the life of the project. The Board therefore welcomes Birch Mountain's commitments to minimize the impact of its project on wildlife as outlined in its application (see also Appendix B).

[140] The Board believes that considerable uncertainty remains with respect to the cumulative effects of the project on endangered plant species and communities, particularly wetland communities. The Board recognizes the difficulty of confirming or categorically ruling out the presence of rare species on a site as large as the proposed mine. The Board will require as a condition that Birch Mountain continue rare plant surveys and provide the results of such work to Alberta Environment in advance of each phase of the mine.

[141] The Board does not believe it would be practical for Birch Mountain to avoid rare plant populations, should they be discovered. However, it would expect the company to report its findings to the Alberta Natural Heritage Information Centre and to seek its advice on the disposition of any specimens found. Without careful characterization and comparison, it is not possible to assess whether the wetland communities found on site are secure elsewhere, or alternatively are threatened by other developments. The Board believes preservation at another

[55] Second Supplemental Information Response. Nov. 2004. Table SIR2-17.2.

site is the only practical mitigation to the loss of a wetland community, given the uncertainties of wetland reclamation.

[142] The Board notes that with regard to the cumulative effects of fine particulate matter, Birch Mountain initially stated[56] that the average $PM_{2.5}$ concentration of 5.9 $\mu g/m^3$ at Fort MacKay was well below the CWS of 30 $\mu g/m^3$. The Board notes that the standard is based on the 98th percentile of daily averages and that the comparison with an average presented in the EIA is not meaningful.

[143] The Board notes that the estimates of the cumulative concentration of $PM_{2.5}$ in the EIA were calculated as the sum of the mean cumulative background and the 98th percentile project emissions. This approach underestimated the contribution of sources other than the quarry to the 98th percentile of the cumulative total. Birch Mountain's assumptions made regarding emission reduction mitigation and quarry depth in the revised estimates presented in the second supplemental response remain speculative.[57] It is also unclear whether the cumulative background concentration used by Birch Mountain in the most recent estimates includes all of the potential sources approved since the 2002 CNRL Horizon EIA modelling. However, the Board is less concerned with the specific numbers than with the conclusion that inhalable particulates could approach or exceed the CWS in the vicinity of the Muskeg Valley Quarry, particularly at the nearby PTI Lodge.

[144] The Board understands that these predictions are necessarily based on simulations and therefore entail some degree of uncertainty. It also understands that some of the simulated sources of particulates may not materialize for several years. Nevertheless, this portion of the cumulative effects assessment identifies a potential problem for the region. The Board encourages Birch Mountain to pursue the dust control measures it has described and to assess on an ongoing basis the need for further measures.

[145] The Board notes that Birch Mountain has committed to intermittent monitoring of particulates,[58] but that no monitoring protocol has yet been designed. The Board notes that unless sufficient data are collected to determine the 98th percentile for comparison with the standard, the monitoring data will be of limited value. The Board therefore recommends that Alberta Environment encourage Birch Mountain and its neighbours to support an appropriate level of air quality monitoring and to share monitoring sites and costs.

[56] Application and Environmental Impact Assessment. March 2004. p. 4-11; Supplemental Information Response, Sept. 2004. AENV/NRCB p. 25.
[57] Second Supplemental Information Response. Nov. 2004. Table SIR2-17.2, p. 2-32.
[58] Application and Environmental Impact Assessment. March 2004. p. 2-26.

4.7 Noise

Views of the Applicant

[146] Birch Mountain identified the expected sources of noise to be generated from drilling, blasting, excavating, conveying, crushing, screening, loading and vehicular movement at the operational mine. It stated that the crushers, screens, front end loaders and haul trucks were expected to be the main source of the noise emissions.

[147] Birch Mountain used a noise measurement scale known as A-weighted sound level, or decibel (dBA) to describe existing and anticipated sound levels. It clarified that this scale gives greater weight to the sound frequencies to which the human ear is most sensitive. Birch Mountain also explained that its description of sound levels was an equivalent level (L_{eq}) meaning sound levels that, when averaged over time, have the same acoustical energy as the summation of all time-varying events over the averaged time period.

[148] Because there are no noise standards available for Alberta that apply directly to limestone quarries, Birch Mountain used the Alberta Energy and Utilities Board (EUB) *Noise Control Directive* (*ID 99-8*) and the companion *Noise Control Directive User Guide* (EUB, 1999b) as regulatory guidelines in the assessment of noise generated from the quarry and its effects at selected receptor locations.

[149] Birch Mountain stated that the EUB *Noise Control Directive* (*ID 99-8*) defines a permissible sound level (PSL) of 40 dBA at a distance of 1.5 km from the source and that permanently or seasonally occupied dwellings should not be exposed to levels in excess of the PSL, even if they are within the 1.5 km distance.

[150] Birch Mountain identified Trapper's Cabin, located about 0.7 km from the western quarry boundary, as a seasonal dwelling as defined in the *EUB Noise Control Directive User Guide*. It also identified the PTI Lodge, which provides accommodations for workers and is located about 0.7 km north of the northwest quarry boundary, as a permanently occupied dwelling. It identified these dwellings as Category 1[59] receptors for which the basic sound level (BSL) of 40 dBA applies.

[151] It applied daytime adjustments of 10 dBA to both receptors and a further 5 dBA for seasonally occupied dwellings and arrived at a PSL of 55 dBA and 45 dBA for daytime and night time, respectively.

[152] Birch Mountain conducted baseline sound level measurements at two locations within the area of the proposed quarry over a 24-hour period in January 2004. Noise levels (dBA) were recorded at one-minute intervals over a 30-minute period, followed by recording L_{eq} and L_{max}. Total sampling time was 4.5 hours at each location and both daytime and night time

[59] Category 1 reflects conditions where a dwelling is more than 500 m from heavily traveled roads and/or rail lines and not subject to frequent aircraft flyovers.

measurements were taken. It reported the baseline L_{eq} to be 42.4 and 43.0 dBA during the daytime, and 35.9 and 34.8 dBA night time for a northern and southern location, respectively.

[153] Birch Mountain used a computer program[60] to predict noise emissions for various operational scenarios and atmospheric conditions. It modelled anticipated noise levels for two development scenarios:

- initial operations on the ground surface before the quarry has been excavated to any significant depth, and
- regular operation with equipment operating at the bottom of the quarry after it would have been deepened to its anticipated depth of about 23 metres below ground level.

It stated that mining activity would be the same at daytime and night time.

[154] Birch Mountain's computer model predicted the anticipated sound levels (background plus operational) at 1500 m from the quarry to be between 65 dBA to the north and 56 dBA to the west for the start-up phase. For later times, when operations are moved to the bottom of the quarry, predicted sound levels at 1500 m remained at 65 dBA to the north, and were within Birch Mountain's calculated permissible sound levels of daytime mining (55 dBA) in other directions.

[155] The computer model was also used to predict noise levels at five locations near the proposed quarry where people would or may be present on a short-term or long-term basis. These were:

- Trapper's Cabin
- PTI Lodge
- an undeveloped campground beside the Muskeg River west of the proposed quarry
- a bridge over the Muskeg River where people occasionally gather to fish, and
- the community of Fort MacKay.

[156] The predicted noise levels (background plus operational) at those locations were as follows (dBA):

	Initial Surface operations		Operational, below ground	
	Day	Night	Day	Night
Trapper's Cabin	51.0	50.4	47.0	45.2
PTI Lodge	54.9	54.7	52.1	51.7
Campground	55.8	55.6	52.1	51.6
Muskeg River Bridge	56.6	56.4	55.4	55.2
Fort MacKay	46.7	45.0	44.9	41.9

[60] SPM9613 developed by Power Acoustics Inc., Orlando Florida.

[157] Birch Mountain indicated that it would adopt a number of measures to minimize noise emissions. These include:

- silencers, mufflers, and shielding to enclose noise generating parts;
- relocating quarry equipment to the base of the quarry, as soon as practical;
- regular equipment maintenance;
- routing of quarry traffic to minimize noise associated with reversing alarms; and,
- maintenance of the access road to minimize generation of road noise.

[158] Birch Mountain stated that it would strive to meet the requirements of the EUB noise directive, whether or not the directive formally applies to the project.

[159] Birch Mountain committed to implement a routine noise monitoring program to support effective management of noise throughout the life of the quarry.[61] It stated that monitoring plans include an evaluation of the predicted PSL when the quarry is in operation and would monitor at standard, pre-selected locations (such as Trapper's Cabin). Birch Mountain also committed to work with local stakeholders and community residents to identify monitoring locations to address specific concerns.

[160] Birch Mountain indicated that it expected noise levels at any single receptor location to vary as the depth of the quarry changes, and as the quarry expands and the position of the quarry face changes.[62] It committed to apply appropriate mitigation measures, if exceedances of the daytime or night time PSL were measured at Trapper's Cabin. Birch Mountain indicated additional mitigation measures that could be implemented include: installation of sound baffles, reorientation of equipment and change in operating schedules to minimize night time noise. Birch Mountain further indicated that noise control measures could include insulation on equipment and modified blasting schedules and would depend on the source and type of noise generated in the quarry operation.[63]

Views of the Board

[161] The Board accepts the use of the AEUB standards of offsite noise impacts as reasonable. However, the Board's interpretation of the AEUB standards differs in two main areas. First, Birch Mountain has calculated the PSL for Trapper's Cabin to be 55 dBA daytime and 45 dBA night time. In doing so, it used an adjustment of +5 dBA for seasonally occupied dwellings. The Board notes that the adjustments of +5 dBA, as defined in the *Noise Control Directive User Guide*, is intended to be applied to seasonally operating facilities and not to seasonally occupied dwellings. The Board finds, therefore, that the PSL for Trapper's Cabin is 50 dBA for daytime and 40 dBA for night time.

[162] Second, Birch Mountain interpreted PTI Lodge to be a Category 1 dwelling and also determined the PSL to be 55 dBA and 45 dBA for daytime and night time, respectively. The

[61] Application and Environmental Impact Assessment. March, 2004. Section 4, p. 4-21.
[62] Supplemental Information Response. Sept. 2004. p. 26, Athabasca Chipewyan First Nations Statement of concern.
[63] Supplemental Information Response. Sept. 2004. p. 6, Athabasca Chipewyan First Nations Statement of concern.

Board finds that PTI Lodge is more aptly described as a Category 2[64] dwelling unit because of its proximity to a heavily traveled road. Furthermore, the Board believes it is proper to add an adjustment in PSL to reflect the dwelling unit density[65] of PTI Lodge. The Board, therefore, determines PSL for the PTI Lodge to be 58 dBA for daytime, and 48 dBA for night time.

[163] The Board finds that the noise levels predicted by Birch Mountain exceed the PSL for Trapper's Cabin for both night time and daytime during the initial development phase, and for night time during full operations. The Board also finds that the predicted noise levels at PTI Lodge exceed the PSL for night time during both the initial development and full operation phases.

[164] Birch Mountain made various commitments in regard to noise emissions from the proposed quarry. While the Board finds Birch Mountain's commitments encouraging, it will impose a condition that the commitments be upheld. These commitments include:

- Adoption of, and adherence to, the requirements of the EUB noise directive.
- Adoption of a variety of operational noise reduction measures such as mufflers, silencers and shielding, equipment and road maintenance, and traffic routing.
- Implementation of a routine noise monitoring program throughout the life of the quarry and in cooperation with and input from local stakeholders and community residents.
- Application of further mitigative measures, if exceedances of permissible sound levels are detected by the monitoring at Trapper's Cabin.

[165] Further, the Board agrees that future monitoring should be done with input from local stakeholders and community residents, including the community of Fort MacKay and residents of PTI Lodge, to ensure that permissible sound levels are not exceeded at those receptors, and that any concerns that may arise are addressed.

[166] The Board is concerned about the accuracy of the predicted noise levels at the key receptors as defined by Birch Mountain. In particular, the Board notes that the noise levels predicted by Birch Mountain's model were determined as though the noise would emanate from a single point, located near the eastern boundary of the quarry. The Board believes that this modelling approach may have considerably underestimated noise levels that would be generated during much of the first quarry phase, and all of the third phase. The Board, therefore, will impose a further condition that Birch Mountain conduct additional modelling to predict sound levels that could reasonably be expected during the proposed third phase of quarrying. This modelling must be done as though the noise was generated in the geometric centre of the third phase of quarrying, and results are to be shared with local stakeholders, community residents, and Alberta Environment.

[64] Category 2 reflects dwelling units that are more than 30 m but less than 500 m from heavily traveled roads and/or rail lines and not subject to frequent aircraft fly over.
[65] A three dBA noise level is added to the PSL to reflect a dwelling unit density of 9 to 160 units per quarter section of land.

5. OPERATIONAL ISSUES

5.1 Mine Development

Views of the Applicant

[167] The Muskeg Valley Quarry will exploit Devonian limestone found in the lower half of the Moberly Member of the Waterways Formation of the Beaverhill Lake Group. Approximately 45m thick, this formation is at or near surface throughout the majority of the lease area. Overlying sediments are described as generally thin (<2m) to absent with the exception of McMurray Formation and Quaternary sediments located in the northeastern part of the project area and along the eastern boundary where McMurray Formation oil sands will be preserved along the flanks of Muskeg Mountain.

[168] The applicant reported that there is approximately 180 million tonnes of limestone in the northern project area available for aggregate production and the potential for more than one billion tonnes of limestone aggregate in the southern project area. Birch Mountain identified some of the deposit suitable for calcining to produce high quality quicklime for industrial applications.

[169] Prior to quarrying, the applicant would clear timber, salvage soil, strip and stockpile overburden and construct an access road. Initial quarry activity would be located primarily in upland areas requiring very little drainage and overburden removal.

[170] Mobile drill rigs would be utilized to place explosives in the quarry wall. The applicant stated that blasting would occur once per day, four or five days a week. Broken limestone at the quarry face would be excavated by tracked hoe and piled. A wheel loader would move the piled materials to one of two mobile crushers located near the quarry wall. Waste rock from Phases 1 and 2 of the quarry would initially be moved to the Phase 3 mining area. Once operations began in Phase 3, the waste rock would be relocated to the northern part of Phase 1, as part of the reclamation process.

Views of the Board

[171] The Board accepts that the proposal for mine development is adequately described and represents a reasonable approach to recovering this resource.

6. ECONOMIC AND SOCIAL ISSUES

6.1 Effects on the Local Economy

Views of the Applicant

[172] Birch Mountain stated that its project would have positive economic and social impacts on the local community. Birch Mountain identified employment opportunities for nearby residents of Fort MacKay. The applicant noted that its project has the support of the Fort McKay Industrial Relations Corporation and the Athabasca Chipewyan First Nation Industry Relations Corporation.

[173] Within a regional context, Birch Mountain indicated that its project would have a small impact on the regional workforce, transportation system or regional infrastructure. Consequently, it concluded that approval of the project would generally have little impact on the regional population, services or infrastructure. In the longer term, Birch Mountain suggested that approval of the quarry would provide a key source of aggregate in this high growth region.

Views of the Board

[174] The Board accepts Birch Mountain's assessment of the impact of its project on the regional economy. Although the project is small, it would offer local residents some employment and business opportunities and, in the longer term, will serve a role in continued regional economic growth. The Board finds that this project will assist in the continued strong economic growth in the region. Sustainable economic activity in the Fort McMurray region has a significant positive effect on the Alberta economy.

6.2 Land Use

Views of the Applicant

[175] The Muskeg Valley Quarry is consistent with the objectives set out in the *Fort McMurray-Athabasca Oil Sands, Subregional Integrated Resource Plan* of 1996. Within the greater area, the quarry is located in the Mildred-Kearl Lakes Resource Management Area. This document provides the following objective for mineral and surface materials: "*To encourage and provide opportunities for the exploration and development of quarriable metallic and industrial, aggregate and other mineral resources, providing such developments are compatible with, or will not jeopardize, existing or future oil sands development projects.*" Birch Mountain stated it would coordinate development plans with oil sands developers and the forest industry FMA holders to eliminate resource development conflicts.

[176] Birch Mountain provided an outline of the regional planning initiatives that were established to respond to the demands of the rapidly growing regional economy. These include the Cumulative Environmental Management Association (CEMA), the Regional Issues Working Group (RIWG), the Wood Buffalo Environmental Association (WBEA) and the Regional Aquatics Monitoring Program (RAMP). The provincial government retains oversight and

ultimate authority over the implementation of strategies developed by these group initiatives. The key process for delivering management strategies to the region remains with the Regional Sustainable Development Strategy (RSDS) for the Athabasca Oil Sands Area. CEMA, RIWG and RAMP are intended to provide for coordinated development and managed growth in the context of a sustainable environment. Birch Mountain expressed an ongoing commitment to working within the framework of these organizations.

[177] The development of the quarry would result in a loss of 0.6% of trapline #2006. Birch Mountain committed to negotiating appropriate compensation for this impact. Recreational opportunities would be reduced during the life of the quarry, however, it is anticipated that reclamation may increase and diversify the recreational potential of this area through the creation of wetlands and ponds.

[178] The Historical Resources Impact Assessment, conducted as part of the Application, identified locations within the project area that established the presence of a major primary toolstone source. As a result of this discovery, two portions of the northern project area were excluded from the quarry development plan and the proposed access road routing has been realigned to respect this significant historical resource.

Views of the Board

[179] The Board notes that The Regional Municipality of Wood Buffalo recognizes the effects on land use and has not raised any concerns to the Board. The Board appreciates that any development of significant size and scope will have land use effects. The Board believes that the existing regional land use initiatives in place in this area will assist Birch Mountain in managing those effects on a regional scale. The Board is satisfied that Birch Mountain is taking a reasonable approach to the direct land use conflicts within the quarry lease area.

6.3 Transportation

Views of the Applicant

[180] The Muskeg Valley Quarry does not include plans for upgrading of regional roads or the bridge across the Muskeg River, nor are any new bridge crossings contemplated as part of the project. Public access to the project area would be controlled with signage and a gate that could be closed if required. Trucks entering the quarry area would enter a truck marshalling yard, and from there would proceed to the loading area. Unauthorized entry would be stopped at the scale house, thus ensuring that the public would not be able to enter the quarry operation. The access road would respect a 200 m setback from the Muskeg River.

[181] Birch Mountain anticipates that a total of 329 aggregate truck trips per day (one-way) would occur on the constructed access road, once the quarry became fully operational. Trucks would enter and leave the quarry 24 hours a day, although the volumes would have a daytime bias. The applicant also expects that as many as 55 heavy hauler trips may occur to adjacent oil sands mines each day, however, these trucks would not utilize public roads other than at designated road crossings.

[182] Overall the changes in truck traffic would include a change in travel patterns as aggregate from the Muskeg Valley Quarry replaces loads from existing aggregate sites, and as demand for aggregate increases it is expected that the capacity of the trucking system would respond accordingly. Overall, Birch Mountain expects minimal impacts from its operation on regional traffic volumes and travel patterns.

Views of the Board

[183] The Board accepts that the transportation of aggregate is an inherent component of this operation. The Board is willing to accept the proponent's position that the amount of aggregate moving throughout the region would grow in relatively small increments as the production from this facility would to a large degree be replacing aggregate production from existing facilities that are reaching the end of their productivity. The Board also recognizes that the movement of aggregate trucks represents a very small component of industrial traffic in this region.

7. DECISION

[184] The Board has carefully considered all of the information provided in the application materials to obtain an adequate understanding of the effects anticipated from the construction and operation of the Muskeg Valley Quarry. When the residual impacts are balanced against the project's benefits to society, the Board concludes that the project is in the public interest. In reaching this conclusion, the Board has given significant weight to the applicant's proposed mitigation measures. Appendix B lists the major mitigation commitments described in the application. The Board's approval is contingent upon the applicant fulfilling its commitments to the mitigation measures detailed in its entire application, which consists of the EIA and supplementary information filed with the Board. The Board has also identified some additional measures that will help ensure the project's residual impacts are minimized, and these measures have been specified as conditions in the Form of Approval.

[185] In completing this review the Board appreciates the role of Alberta Environment in assuring that the EIA provides the necessary information to develop an understanding of the environmental effects associated with this project. Having regard for the important ongoing role of Alberta Environment in the regulation of industrial mining activities, the Board has included recommendations in this report for its consideration.

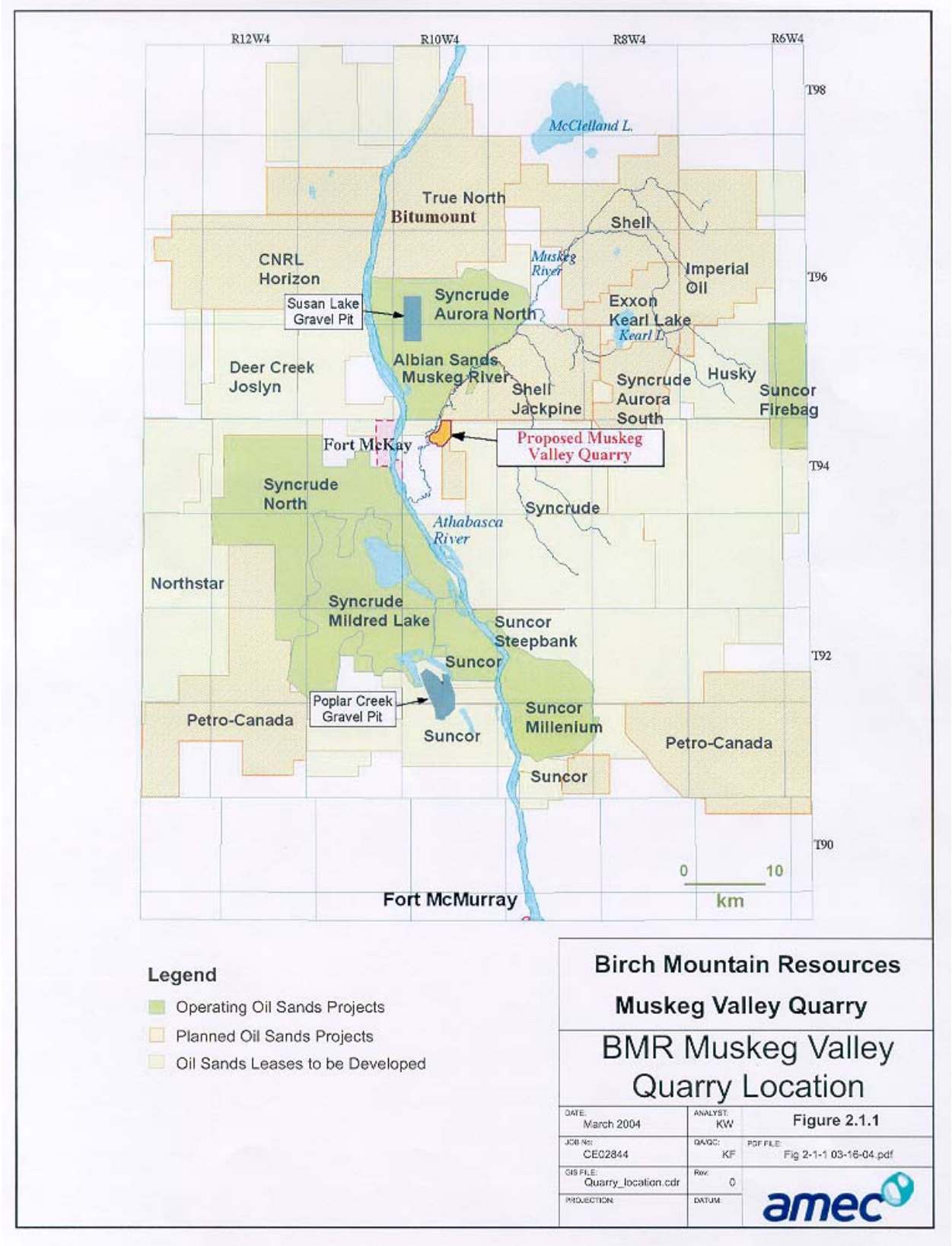
[186] The Board realizes that there are intrinsic uncertainties associated with any resource development project. As Birch Mountain proceeds with mining activities, the Board expects that additional opportunities for enhancements or refinements may arise. The Board encourages the operator to explore such opportunities for enhanced mitigation as they emerge. The Board commends the applicant's commitment to ongoing dialogue with the local community and expects full cooperation with the relevant regulatory bodies regarding monitoring, and implementing or altering required mitigation.

[187] The Board has carefully considered all of the evidence pertaining to this application and has summarized the material findings in the body of this report. Accordingly, the Board is prepared, with the authorization of the Lieutenant Governor in Council, to approve Birch Mountain's application No. 0401 subject to the conditions in the Form of Approval (Appendix C). These conditions are intended to have regard for the public interest by directing the management of future issues to the appropriate regulatory bodies.

APPENDIX A:

General Location Map [66]

[66] Application and Environmental Impact Assessment. March 2004. Figure 2.1.1 Muskeg Valley Quarry Location.


R12W4
R10W4
R8W4
R6W4
T98
T96
T94
T92
T90
McClelland L.
True North
Bitumount
Shell
CNRL
Horizon
Muskeg
River
Imperial
Oil
Susan Lake
Gravel Pit
Syncrude
Aurora North
Exxon
Kearl Lake
Kearl L.
Deer Creek
Joslyn
Albian Sands
Muskeg River
Shell
Jackpine
Syncrude
Aurora
South
Husky
Suncor
Firebag
Fort McKay
Proposed Muskeg
Valley Quarry
Syncrude
North
Syncrude
Athabasca
River
Northstar
Syncrude
Mildred Lake
Suncor
Steepbank
Suncor
Poplar Creek
Gravel Pit
Petro-Canada
Suncor
Suncor
Millenium
Petro-Canada
Suncor
0
10
km
Fort McMurray
Legend
Operating Oil Sands Projects
Planned Oil Sands Projects
Oil Sands Leases to be Developed
Birch Mountain Resources
Muskeg Valley Quarry
BMR Muskeg Valley
Quarry Location
DATE: March 2004
ANALYST: KW
Figure 2.1.1
JOB No: CE02844
QA/QC: KF
PDF FILE: Fig 2-1-1 03-16-04.pdf
GIS FILE: Quarry_location.cdr
Rev: 0
PROJECTION:
DATUM:
amec

APPENDIX B:

SUMMARY OF EIA MITIGATION COMMITMENTS

Appendix B: Summary of EIA Mitigation Commitments

The NRCB views the development plans for any project as an opportunity for an applicant to identify any potential adverse effects and make appropriate commitments to mitigate their impact. The Board relies on these undertakings in making its determination that a project is in the public interest. Therefore, the commitments form an integral part of the approval.

The Board has identified the significant commitments made by Birch Mountain in its application materials for the Muskeg Valley Quarry, and has compiled a separate Supplemental Listing of Birch Mountain Commitments for convenient reference and to promote brevity of this Panel Decision Report. For a more detailed review of the applicable commitments, the supplemental listing is available at the NRCB's Edmonton office. Additionally, copies of all application materials are available for viewing at the NRCB's Edmonton office.

A summary of Birch Mountain's commitments are referenced according to the following index:

1.	**Blasting Protocol**	Page 2-12	Application and Environmental Impact Assessment. March 2004.
		Page 6-13	Supplemental Information Response. Sept. 2004.
2.	**Potable Water & Sewage**	Page 2-14	Application and Environmental Impact Assessment. March 2004.
3.	**Explosives Storage**	Page 2-16	Application and Environmental Impact Assessment. March 2004.
4.	**Muskeg River Setback**	Page 2-18	Application and Environmental Impact Assessment. March 2004.
5.	**Seepage and Runoff**	Page 2-19	Application and Environmental Impact Assessment. March 2004.
6.	**Quarry Water Use**	Page 2-19	Application and Environmental Impact Assessment. March 2004.
7.	**Hazardous Materials**	Page 1-21	Application and Environmental Impact Assessment. March 2004.
8.	**Garbage Storage**	Page 2-22	Application and Environmental Impact Assessment. March 2004.
9.	**Road Construction**	Page 2-22	Application and Environmental Impact Assessment. March 2004.

10. Fuel Storage	Page 2-23	Application and Environmental Impact Assessment. March 2004.
11. Archaeological Area	Page 2-23	Application and Environmental Impact Assessment. March 2004.
	Page 5-130	Application and Environmental Impact Assessment. March 2004.
	Page 149	Supplemental Information Response. Sept. 2004 (AENV/NRCB).
12. Reclamation Plan	Page 2-24	Application and Environmental Impact Assessment. March 2004.
	Page 2-13	Supplemental Information Response. Sept. 2004.
	Page 13	Supplemental Information Response. Sept. 2004 (FMFN).
13. Clearwater Quarry Lake	Page 2-28	Application and Environmental Impact Assessment. March 2004.
	Page 6-45	Application and Environmental Impact Assessment. March 2004.
	Page 95	Supplemental Information Response. Sept. 2004 (AENV/NRCB).
14. Environmental Monitoring	Page 2-35	Application and Environmental Impact Assessment. March 2004.
15. Air Quality Control	Page 4-11	Application and Environmental Impact Assessment. March 2004.
	Page 2-26	Supplemental Information Response. Sept. 2004.
	Page 5	Supplemental Information Response. Sept. 2004. (FMFN).

16. Noise Mitigation	Page 4-21	Application and Environmental Impact Assessment. March 2004.
	Page 2-26	Supplemental Information Response. Sept. 2004.
	Page 30	Supplemental Information Response. Sept. 2004. (ACFN).
17. Surface Impact Mitigation	Page 5-53	Application and Environmental Impact Assessment. March 2004.
18. Drainage System	Page 5-53	Application and Environmental Impact Assessment. March 2004.
19. Habitat Enhancement	Page 5-111	Application and Environmental Impact Assessment. March 2004.
20. Wildlife Monitoring and Management	Page 5-113	Application and Environmental Impact Assessment. March 2004.
	Page 5-114	Application and Environmental Impact Assessment. March 2004.
	Page 2-27	Supplemental Information Response. Sept. 2004.
	Page 5-36	Supplemental Information Response. Sept. 2004.
21. Groundwater Analysis	Page 6-15	Application and Environmental Impact Assessment. March 2004.
	Page 59	Supplemental Information Response. Sept. 2004 (AENV/NRCB).
22. Surface Water Quality	Page 6-32	Application and Environmental Impact Assessment. March 2004.
	Page 7-3	Supplemental Information Response. Sept. 2004.

23. Fish Inventory	Page 6-43	Application and Environmental Impact Assessment. March 2004.
	Page 6-4	Supplemental Information Response. Sept. 2004.
24. Muskeg River Monitoring	Page 6-44	Application and Environmental Impact Assessment. March 2004.
	Page 2-28	Supplemental Information Response. Sept. 2004.
25. Timber Clearing	Page 2-9	Supplemental Information Response. Sept. 2004.
26. Salvaged Topsoil	Page 2-12	Supplemental Information Response. Sept. 2004.
	Page 2-20	Supplemental Information Response. Sept. 2004.
27. Grading and Recontouring	Page 2-20	Supplemental Information Response. Sept. 2004.
28. Reforestation and Wetland	Page 2-20	Supplemental Information Response. Sept. 2004.
	Page 117	Supplemental Information Response. Sept. 2004. (AENV/NRCB)
29. Bitumen Limestone	Page 60	Supplemental Information Response. Sept. 2004. (AENV/NRCB)
30. Working Groups	Page 2	Supplemental Information Response. Sept. 2004. (FMFN).
31. Slash Burning	Page 4	Supplemental Information Response. Sept. 2004. (FMFN).
32. Daily Truck Trips	Page 8	Supplemental Information Response. Sept. 2004. (FMFN).
33. Resident Access	Page 9	Supplemental Information Response. Sept. 2004. (FMFN).

34. Trapper's Compensation	Page 12	Supplemental Information Response. Sept. 2004. (FMFN).
35. Weed Control Program	Page 19	Supplemental Information Response. Sept. 2004. (FMFN).
36. Staff Fishing Policy	Page 35	Supplemental Information Response. Sept. 2004. (FMFN).
37. First Nations Input	Page 5	Supplemental Information Response. Sept. 2004. (ACFN).

APPENDIX C:

FORM OF APPROVAL

Appendix C: Form of Approval

THE PROVINCE OF ALBERTA
NATURAL RESOURCES CONSERVATION BOARD ACT
NATURAL RESOURCES CONSERVATION BOARD

IN THE MATTER of a project of Birch Mountain Resources Limited for approval to construct a limestone quarry (the Project) located approximately 60 km north of Fort McMurray and 6 km east of Fort MacKay

APPROVAL NO. NR–2005-1

WHEREAS the construction of a limestone quarry located approximately 60 km north of Fort McMurray and 6 km east of Fort MacKay by Birch Mountain Resources Limited (hereinafter called "Birch Mountain") is a reviewable project under s.4(c) of the *Natural Resources Conservation Board Act* being chapter N- 3 of the Statutes of Alberta, 2000; and

WHEREAS the Natural Resources Conservation Board is prepared to grant approval to the application by Birch Mountain, subject to the conditions herein contained, and the Lieutenant Governor in Council has given authorization, hereto attached.

THEREFORE, the Natural Resources Conservation Board hereby orders as follows:

1. The project of Birch Mountain, for construction and operation of a limestone quarry located approximately 60 km north of Fort McMurray and 6 km east of Fort MacKay, as described in Application No. 0401, from Birch Mountain to the Board filed March 15, 2004 and all supplemental material supporting the Application filed with the Natural Resources Conservation Board, is approved, subject to the undertakings and commitments in the application and the terms and conditions herein contained.

2. Birch Mountain shall, to the satisfaction of Alberta Environment, design and implement a particulate air quality monitoring program to obtain data suitable for comparison with the Canada Wide Standard for $PM_{2.5}$.

3. Birch Mountain shall, to the satisfaction of Alberta Environment, establish criteria for the release of water from the quarry settling pond sump. Birch Mountain shall provide water quality data to and obtain permission from Alberta Environment prior to any release.

4. Birch Mountain must, to the satisfaction of Alberta Environment, update its quarry reclamation plan every 5 years, rather than every 10, to incorporate the most up to date research regarding reclamation, revegetation, and rare plant mitigation for the region.

5. Birch Mountain must conduct rare plant surveys and provide the results of such work to Alberta Environment in advance of each mine phase.

6. Birch Mountain must:

    - Adhere to the requirements of the EUB noise directive.

    - Adopt noise reduction measures such as mufflers, silencers and shielding, equipment and road maintenance, and traffic routing, all as more particularly described in the Application.

    - Implement a routine noise monitoring program throughout the life of the quarry in cooperation with, and on input from, local stakeholders and community residents.

    - Apply further mitigative measures if exceedances of permissible sound levels are detected by the monitoring at Trapper's Cabin.

7. Birch Mountain shall conduct additional modelling to predict sound levels that could reasonably be expected during the proposed third phase of quarrying. This modelling must be done as though the noise was generated in the geometric centre of the third phase of quarrying, and results are to be shared with local stakeholders, community residents, and Alberta Environment.

Made at the City of Calgary, in the Province of Alberta, this _____ day of _____, 2005.

NATURAL RESOURCES CONSERVATION BOARD

Original signed by:

Brady D. Whittaker	**Gordon Atkins**	**William Young Kennedy**
Chair	**Member**	**Acting Member**

APPENDIX D:

GLOSSARY AND ABBREVIATIONS

Appendix D: Glossary and Abbreviations

µg/m³	Micrograms per cubic metre
AAQG	Alberta Ambient Air Quality Guidelines
Adverse Effect	An undesirable or harmful effect to an organism (human or animal), indicated by some result such as mortality, altered food consumption, altered body and organ weights, altered enzyme concentrations or visible pathological changes.
AENV	Alberta Environment
AEPEA	Alberta Environmental Protection and Enhancement Act
AlPac	Alberta Pacific Forest Industries Inc.
Ambient air	The air in the surrounding atmosphere.
Anthropogenic	Man-made
A-Weighted Sound Level or dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
AWI	Alberta Wetland Inventory. A system of classifying and mapping wetlands on the basis of vegetation composition, peat characteristics, and water dynamics in the system.
Background	An area not influenced by chemicals released from the site under evaluation.
Baseline	A surveyed condition which serves as a reference point to which later surveys are coordinated or correlated.
Basic Sound Level	The allowable sound level at a residential location, as defined by the EUB Directive, with the inclusion of industrial presence based upon dwelling unit density and proximity to transportation noise sources.
BSL	Basic Sound Level
CWS	Canada Wide Standard
CCME	Canadian Council of Ministers of the Environment
CEA	Cumulative Effects Assessment
CEMA	Cumulative Environmental Management Association
CEPA-FPWAGAQOG	Canadian Environmental Protection Act Federal-Provincial Working Group on Air Quality Objectives and Guidelines
cm	Centimeter
CNRL	Canadian Natural Resources Limited
COC	Chemical of Concern
CWS	Canada-Wide Standard

dB (decibel)	A unit of measure of sound pressure equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals.
dBA (decibel A)	Unit used for 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DFO	Department of Fisheries and Oceans
EIA	Environmental Impact Assessment. A review of the effects that a proposed development will have on the local and regional environment.
Endangered Species	A species facing imminent extirpation or extinction in Canada (COSEWIC 1997).
Energy Equivalent Sound Level or L_{eq}	A single number descriptor commonly used for environmental noise measurements and criteria. It is used to quantify sound that constantly varies over time, such as that commonly occurring in outdoor environments. It is defined as the steady, continuous sound level over the measured time period that has the same acoustic energy as the actual fluctuating sound levels that occurred during the same time period. Measurement periods commonly used for L_{eq} measurements and criteria are the daytime (07:00 - 22:00 hrs) and night time (22:00 - 07:00 hrs) periods.
EPEA	*Environmental Protection and Enhancement Act* (Alberta)
EUB	Alberta Energy and Utilities Board
Exceedance	An emission or ambient concentration whose measured value is beyond that allowed by government regulations. Depending upon the regulation, an exceedance may occur if the measured value is higher, or lower, than that defined in the regulation.
Exposure Pathway	The route by which a receptor comes into contact with a chemical or physical agent. Examples of exposure pathways include the ingestion of water, food, and soil, the inhalation of air and dust, and dermal absorption.
flocculant	A reagent added to a dispersion of solids in a liquid to bring together the fine particles.
FMA	Forest Management Area
GHG	Greenhouse gas. A substance in air that traps radiated heat from the Earth, thereby increasing ambient temperatures.
Glaciofluvial	Sediments or land-forms produced by meltwaters originating from glacier/ice sheet.
Groundwater	Subsurface water that occurs beneath the water table in soils and geological formations (in the pores/voids within rocks both unconsolidated and consolidated) that are fully saturated. It is the water within the Earth that supplies water wells and springs.
Habitat	The part of the physical environment in which a plant or animal lives.
HQ	hazard quotient
HRIA	Historical Resources Impact Assessment. A review of the effects that a proposed development will have on the local and regional historic and prehistoric heritage of an area.
HSI	Habitat Suitability Index. A model system that integrates the important ecological parameters (food availability, nesting/den requirements, responses to disturbances, etc.) for a wildlife species to allow for an evaluation of baseline conditions and project effects.
Hydraulic Conductivity	A coefficient "k" depends on the physical properties of formation and fluid. It describes the ease with which a fluid will flow through a porous material.

Hydraulic Gradient	The change in hydraulic head per unit of distance in a given direction. If not specified, the direction generally is understood to be that of the maximum rate of decrease in head. This coefficient is dimensionless.
in-situ	In place (Latin)
karstification	Formation of the features of karst topography by the chemical, and sometimes mechanical, action of water in a region of limestone, dolomite or gypsum bedrock
L_{eq}	Energy Equivalent Sound Level
LSA	Local Study Area
MPOI	Maximum Point of Impact
napthenic acids	Any of the derivatives of cyclopentane, cyclohexane, cycloheptane, or other napthenic homologs derived from petroleum.
PAH	Polyaromatic Hydrocarbons
Permissible Sound Level (PSL)	The allowable overall A-weighted sound level of noise from energy industry sources, as specified by the EUB Noise Control Directive, which may contribute to the sound environment of a residential location.
PM_{10}	Particulate matter with nominally smaller than 10 µm in diameter.
$PM_{2.5}$	Particulate matter – fine fraction (particles less than 2.5 µm in diameter).
PSL	permissible sound level
RAMP	The Regional Aquatics Monitoring Program
Receptor	A general term describing a person or organism subjected to an exposure (e.g. air, water, noise) or disturbance associated with the development being proposed.
RIWG	Regional Issues Working Group
RSDS	The *Regional Sustainable Development Strategy for the Athabasca Oil Sands Area*, a document that sets out the provincial framework for development of management strategies for resolution of environmental issues.
TDS	Total dissolved solids, in water.
TSP	Total Suspended Particulates. Dust and other particles in air.
TSS	Total Suspended Solids, in water
VOC	Volatile Organic Compound. A class of organic chemicals that volatilize under ambient conditions. May be of natural or anthropogenic origin.