To: John Masterson, Director **April 20, 2006**

Oil and Gas Management Branch
Energy Mines and Resources
Box 2703
Whitehorse, Yukon
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Re: Yukon Energy, Mines and Resources, Oil and Gas Management Branch critique of Pembina's June 2005 report entitled "A Peak into the Future".

This letter is in response to the report (Technical Review of the Pembina Report "A Peak in to the Future") prepared by the Government of Yukon, Department of Energy Mines and Resources, Oil and Gas Management Branch and posted on the Oil and Gas Management Branch Website. This letter responds to the Yukon Government's criticisms in the report and makes clear the intent of the Pembina report.

The Pembina report was prepared using the best available information at the time and it was based on actual practices in the field. We also compared these practices with best practices and showed how much difference it would make if best practices were employed. The report's modeling assumptions are conservative, reasonable, and referenced.

"A Peak into the Future" (the Peak report) prepared by the Pembina Institute on behalf of Canadian Parks and Wilderness in Yukon, NWT and the Canadian Arctic Resources Committee was released on June 5, 2005. The report provided for the first time an estimate of the extent and pace of development that could occur if known and potential reserves of gas hydrocarbons are developed in three fields within northern Canada: the Mackenzie Delta, Colville Hills and Peel Plateau. In this study ALCES, a landscape-scale simulation model, was used to estimate the industrial footprint in the three fields using typical gas field development assumptions over the next 30 years. The model was also used to explore how that footprint would change if several "best practices" that are currently used in the gas industry on a case by case basis were uniformly adopted. The model results were represented on spatial maps to communicate the outcomes to the public. An important next step identified in the Peak report is an evaluation of the environmental and social costs and benefits based on development scenarios.

Our responses to the main criticisms are included below. This was made difficult by the fact that the Yukon Government review does not include references to back up the statements made by the author(s) in the Yukon Government review, except one; the Yukon Government's "Yukon Oil and Gas: A Northern Investment Opportunity 2005" document that was published after the Peak report had been released.

The Yukon Government review argues that best practices should form the basis of the assumptions used in the model. We are pleased that the Yukon government is committed to developing regulations and standards based on best practices. However, we note that it has published no such regulations or standards to date. We did include a detailed discussion about best practices and the effect that they would make to reduce the physical footprint of oil and gas if these practices were to become the minimum government requirement. Unfortunately, this section was not reviewed by the Yukon Government. Had the Yukon Government done so, it would have noted that many of the "best practices" that it advocates were also recommended in the Peak Report.

The Peak report provides a tool that can be used by planning organizations to estimate the extent and pace of development that could occur if known and potential gas reserves are developed using typical practices that are utilized in AB/BC or proposed in the Mackenzie Delta. The explicit purpose of the report is to evaluate the extent to which best practices could reduce the physical footprint of gas development in the North. Development scenarios such as in the Peak report are adaptive, and as explained on pg. 30, are intended to be rerun and continually improved with new information.

We are pleased that the Yukon Government has undertaken their own review of potential cumulative development in the Eagle Plains and Peel Plateau. This is a first step in assessing the cumulative effects of gas development which can then be used evaluate the economic, social and environmental tradeoffs associated with particular development scenarios.

Please see attached a detailed response to "A Technical Review of the Pembina Report "A Peak into the Future." We would be pleased to discuss this report and share our experience of the oil and gas development with the Yukon Government. Please contact Pembina's Calgary office.

Sincerely,

Chris Severson-Baker
Director of the Energy Watch Program
Pembina Institute

CC. Canadian Parks and Wilderness Society, Yukon
Canadian Parks and Wilderness Society, NWT
Canadian Arctic Resources Committee
Yukon Land Use Planning Council
North Yukon Planning Commission
Peel Watershed Planning Commission

Pembina Institute Detailed Response to
"A Technical Review of the Pembina Report "A Peak into the Future."

Note: Text in bold is from the Yukon Government Review

Executive Summary

"Future exploration and development in the Peel Plateau is open to speculation and subject to many unknowns; what is certain, however, is that it will not resemble the scenario presented by the Pembina Institute report."

Pembina used typical gas field practices from other known gas field developments in Alberta and BC and also information for proposed developments in the Mackenzie Valley area. We are encouraged that the Yukon Government, in its critique states that the outcomes as predicted in the Peak report using conventional practices will not happen; however, the Yukon Government has not set regulations; or, established thresholds to guarantee the desired outcome. Consequently, the Yukon Government position relies on articles of faith rather than tangible standards to ensure that typical, current field practices do not unnecessarily degrade this area.

A1. Amount of seismic over time

"It is clear that the assumption of 17km/well is a simplistic relationship to begin with; it does not realistically model the different rates of seismic and drilling and will yield an inflated effects."

The Peak report assumed 17 km/well based on data from the British Columbia data from Oil and Gas Commission, Activity Level, Industrial Activity, OGC Activity Report (Other); www.ogc.gov.bc.ca/sitemap.asp. This assumption is not simplistic in any way. Because this factor is on a per well basis and because the wells drilled are a function of the reserves in the area, the amount of seismic that is run is also directly a function of the reserves. This mathematical approach in ALCES results in the seismic activity following a similar bell curve as production. Over time, the seismic drops off as more and more of the reserves are produced. Fundamentally, the amount of seismic that is run is directly proportional to the amount of reserves that remain to be produced. Moreover, the Yukon Government implies that it was the intent of the report to generate "inflated effects'. The Pembina Institute prides itself on its accurate and well supported research. The notion that the Institute arbitrarily selected numbers to inflate the size of seismic footprint in the model is simply false.

A2. Seismic Line Width:

"The Pembina report assumption of a uniform five metre line width is not, as is claimed, a conservative assumption, but in fact overestimates the width of lines by approximately 50% to

400%, compared to recent historical and proposed Yukon seismic activity."

The Pembina Institute report's base scenario for the Peel Plateau, without the use of seismic best practices, assumes an average of 5m widths. This is clearly not a best practice; however these widths are currently used throughout the Western Canadian Sedimentary Basin. The Mackenzie Valley Environmental Impact Review Board defines conventional seismic as 6-8 meters in width, low impact seismic as lines between 1.5 m- 4.5m with an objective of narrow, meandering lines. Minimal impact seismic can be heliportable and requires cutting lines for walking access or using existing lines (MVEIRB, 2003).

It appears from the Yukon Government review that it would accept nothing wider than 1.5 meters, which we are pleased to see. Yet we are not aware of any Yukon regulations or standards to support this inference. In particular, the *Yukon Oil and Gas Act, Yukon Geoscience Regulations* and the *Yukon Geoscience Exploration Guidelines* do not reference seismic line widths or standards for seismic line widths.

In the best practice section of the Pembina report, we modeled two meter seismic lines that were shown to have a significant impact on the total potential footprint of development. As a result of smaller seismic widths, the surface area footprint of the case study was reduced by 11%. In the Peak report we note that best practices as modeled can reduce the environmental impact of gas development but do not eliminate it.

The critique claims **"all seismic in the Yukon since devolution in 1998, and in fact since the last programs in the 1980s, has been heliportable, ie. less than 1.5 meter wide."** The Yukon Government granted approval to a major seismic program that would use 3-4 metre right of ways as recently as 2000 (Devon Canada, 2000). Devon wrote the following about their 2001 seismic program: "The program was originally planned as a ground base drilling and loading program; however, due to uncharacteristically late winter deep snow conditions in winter 2001, and the late start-up (February 9, 2001) for the project, the **majority** of the drilling and loading operation was completed as a fully heli-portable operation" (Devon Canada, 2001:7). We understand that a portion of the program was conducted using ground-based techniques.

A3. Seismic Line Configuration

"Recent and future seismic programs in the Yukon have and will employ meandering lines as standard practice…These lines will be very difficult to see from the air and can be virtually undectable from the ground if done correctly".

Meandering seismic lines are a best practice in the industry. The Peak report didn't go into whether the lines were meandering or not. The Peak report did not include an environmental assessment of the impacts of the total physical footprint. If an environmental assessment of the cumulative development scenario were done as we recommend the question of whether the lines are straight or meandering would become relevant.

A4. Seismic Line "Linear Footprint"

"The [Peak] report considers two kinds of footprint of developments- areal, with units of area, (e.g. km2) and linear (with units of km/km2). While the areal component is straightforward, the linear portion is of questionable value."

The Yukon Government does not have regulations or standards in place that require a maximum of 1.5 m wide seismic lines therefore this would have been an inappropriate assumption for the model. The Peak report did examine the changes that occur in the physical footprint if all seismic lines were reduced to 2 metres or less (pg. 27).

The linear footprint of development can be used to measure the level of fragmentation in an area. Numerous studies and literature reviews have been conducted on key wildlife species, eg. caribou and grizzly bears, to identify the critical linear fragmentation thresholds, after which point populations can begin to decline (Anderson et al, 2002; Salmo Consulting et al, 2004; Salmo Consulting et al. 2003).

B1. Overlap of linear features

The Pembina Institute report included a hypothetical case study of gas development using best practices and applied it to the scenario for the Colville Hills. Linear features were modeled as overlapping by 50% and were shown to have a significant impact on the total potential footprint of development. As a result of overlapping linear development, the surface area footprint of the case study was reduced by 29% and the linear footprint (km/km^2) by half (pg. 27).

B2. Wells per pad

"**It is also reasonable to expect [proponents] to minimize this burden by grouping wells and facilities into the minimum number of assessable sites."**

"**In the great majority of field development scenarios…. Pembina report exaggerates the number of well pads by a factor of approximately four."**

Multiple-wells per pad is a best practice, but only technically and economically feasible under certain circumstances. Without information on the size of proven reserves (for which there were none at the time of the study), on the aerial extent of reserves, on porosity, permeability, depth of wells and thickness of pay, it is not possible to assume that multi-well pads will be the norm in the Peel especially considering the dispersed nature of the potential reserves in the Peel. By far the majority of wells drilled in every gas field in Alberta, in Ft. Laird, NE BC and in Pointed Mountain are individual wells. The potential reserves in the Peel are unlike like the proven reserves in the

Delta where a single field (Taglu) has huge gas reserves over a very small surface area.

In the best practice section of the Peak report, multiple wells per pad were modeled and were shown to have a significant impact on the total potential footprint of development. As a result of overlapping linear development, the surface area footprint of the case study was reduced by 53% for six wells per pad (pg. 27).

B3. Roads

The model was representing linear disturbances and therefore does not differentiate between an all-weather road and winter road. Indeed, a winter road will have less environmental impact. However, in treed areas, both roads will still require the clearing of vegetation. Indeed, the assumed 30m right of way as proposed by Mackenzie Gas Project proponents is very wide. Thirty meters wide roads are typical for hauling large well site equipment, especially if there is a slope (where hill cutting is required). A better practice would be to have smaller width roads, as is mentioned in the best practices section (pg. 28). The width of the ROW has no impact on the linear density (km/km2) only on the overall footprint (km2).

B4 Pipelines

The Peak report has modeled both intra-field pipelines and inter-field pipelines. The pipeline factor inputted into ALCES accounts for both flow lines to individual wells plus flow lines (or more commonly referred to as "gathering lines") between groups of wells and a gas plant. Liquids from gas are seldom, if ever collected at individual well sites and sent to the gas plant using a separate liquid line. It is the norm to recombine the liquids with the raw gas at the well site after the gas has been metered and send the combined stream of gas and liquids down the flow lines and gathering lines to be extracted at a gas plant.

In the best practice section of the Peak report, we modeled the impact of overlapping linear features (pipelines, roads and seismic lines) by 50% that were shown to have a significant impact on the total potential footprint of development. As a result of overlapping linear development, the surface area footprint of the case study was reduced by 29% and the linear footprint (km/km2) by half (pg. 27).

As mentioned in the Peak report, for most gathering systems, 20 m is typical or even as low as 15 m (pg. 28).

B5 Production Profile

“By erroneously assuming unlimited pipeline capacity, the report overestimates the total amount of all development infrastructure – inter-field ….”

It is a reasonable assumption that capping capacity on the transmission line will have little impact on

the number of wells drilled or km of pipeline built. A cap on the transmission line will primarily only affect the rate at which gas is produced, not the total volume of gas produced. The ultimate volume of gas produced will be the same whether the pipeline is designed for 1 bcfd or 1.5 bcfd, it will just take longer to produce. Hence the amount of infrastructure, for the most part, will also be the same. Again, it will just take longer to produce all of the gas. Fields that are farther away from the transmission line and fields with more marginal reserves will only be connected once the pipeline capacity is available due to a decline in a field that was previously connected or if gas prices support a transmission line expansion. If there is a cap on the pipeline capacity, it is not a matter of how much infrastructure is required, it is more about when it is required. For individual fields with very high porosity/permeability, there may be some minor savings in infrastructure if the production is delayed due to a cap on transmission line capacity. However, we do not believe this to be the norm, given that proponents will typically bring on new gas on a field-by-field basis under pre-contracted capacity on the transmission line.

C1 Zone of influence

As in the Pembina report, the Yukon Government's review brings up the importance of evaluating the potential environmental impacts of gas development. An evaluation of the zone of influence associated with the gas development infrastructure, such as has been done through the United Nation's GLOBIO methodology, was outside the scope of the Peak report but would be a valuable exercise to further understand direct and indirect environment effects. We look forward to the Yukon Government's evaluation of the potential environmental impacts of gas development in the Yukon.

C2 Reserves Forecast:

The Yukon Government published "Yukon Oil and Gas: A Northern Investment Opportunity" in June 2005, a "joint work by the Yukon Geological Survey and the Geological Survey of Canada". In their review they state "…it is difficult to understand why the Pembina report would present the relative potential of the Peel Plateau and Peel Plain areas as effectively the opposite of what is expected by the Yukon Geological Survey and the Geological Survey of Canada.

The "Yukon Oil and Gas: A Northern Investment Opportunity 2005" was released after the Peak Report had been completed.

As mentioned in the *Peak* report, "Physical surface areas of the study regions were extrapolated from documents that reported on associated reserve estimates" (pg.9). For the Peel Plateau this information came from the National Energy Board's 2000 report, *Petroleum Resource Assessment of the Peel Plateau, Yukon Territory, Canada*. In the NEB report the Disturbed Belt of the Peel Plateau ($48\ 10^9 m^3$) contains more reserves than the Plains Area ($16.5\ 10^9 m^3$) (NEB 2000: 36).

The reserve numbers between the Yukon Government report and the NEB report are very similar. The mean marketable gas reserves from the NEB report are 2.29 TCF (64.4 $10^9 m^{3)}$ and in the Yukon Government's report "Yukon Oil and Gas: A Northern Investment Opportunity 2005" are 2.945 TCF.

Graphical Representation of Peel Plateau Development

The Yukon Government review goes into detail on how the symbology is not to scale however the map clearly states "symbology not to scale." The Yukon Government in their review of the maps implies that the maps are intentionally misleading. This implication is false.

The Peak report makes no claim that the maps were produced by ALCES. They were produced using the outputs of ALCES.

Sources:

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Mackenzie Valley Environmental Impact Review Board. 2003. Reference Bulletin: Preliminary Screening of Seismic Operations in the Mackenzie Valley. http://www.mveirb.nt.ca/documents/guidelines/reference_bulletins/draft_Seismic_Reference_Bulletin_29-10-03_.pdf

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