Paramount resources ltd.

4700 Bankers Hall West, 888 3rd Street SW Calgary, Alberta, Canada T2P 5C5 www.paramountres.com
tel 403 290 3600 fax 403 262 7994

July 27, 2001

Mackenzie Valley Environmental Impact Review Board
Box 938
200 Scotia Centre (5102 - 50 Avenue
Yellowknife, NT
X1A 2N7

Via Fax: (867)920-4761

Attention: Joe Acorn, Environmental Assessment Officer

Dear Sir:

Re: Paramount Resources Cameron Hills Environmental Assessment
Information Requests
Your File EA00-004

On July 17, 2001 Paramount Resources Ltd. ("Paramount") received information requests from your office from the Department of Education, Culture and Employment of the Government of the Northwest Territories ("GNWT"), Environment Canada ("EC") and Mandell Pinder Barristers & Solicitors ("Mandell Pinder"). The following information is being provided in response to those information requests.

GNWT Information Request #1(a)

Request: Please provide further quantitative data showing the number of skilled and unskilled workers required for the project.

Response: Paramount will not determine the final project scope or scheduling until just prior to project initiation, thus total employment requirements are difficult to predict with certainty.

Though multiple wells are planned, it is possible that only two wells may be drilled and evaluated as the project scope is subject to each prior well's success, weather conditions and equipment availability. We therefore submitted in Table 5-1 the number of personnel required for one well and in Table 5-2 the numbers if all nine wells are drilled and evaluated.

GNWT Information Request #1(b))

Request: Please provide forecasted number of workers from local communities.

Response: Northern content will be determined when the project scope is finalized, and an evaluation of northern goods and services available at that time to meet equipment, timing and bidding specifications are known.

EC Information Request #1

Request: Drilling wastes are to be disposed of on the lease at various sumps following testing. Are all waste materials to be analysed and disposed of as per the Alberta Energy and Utilities Board guide for waste management? This document includes the requirement for Microtox testing of sump supernatants prior to discharge, will the proponent include such testing?

Response: Until such time as the Northwest Territories has its own Drilling Waste Management guidelines in place; Paramount will adhere to the AEUB Guide 50 - Drilling Waste Management as well as AEUB Guide 58 -Oilfield Waste Management Requirements for the Upstream Petroleum Industry. Paramount will be using a Gel-chem polymer drilling mud system. As Guide 50, section 1, page 1 indicates discharge or pump-off is an off-site disposal method. Paramount intends to employee the mix-bury-cover as indicated by item 7 on page 2 of the Environmental Impact Assessment in Response to the Terms of Reference for the Paramount Resources Ltd Cameron Hills Drilling Project dated June, 2001, which the same guide reference indicates is an on-site disposal method. A bioassay based toxity assessment is conducted for both fluid and solid components of drilling waste by a competent consultant for the presence of potential toxicants such as: bactercides, corrosion inhibitors, defoamers, emulsifiers and de-emulsifiers, foaming agents, lubricants, polymer stabilizers and breakers, shale control inhibitors, hydorcarbons and sufactants. All potential contaminates and other drilling wastes will be characterized, manifested and transported to an approved waste facility for disposal in accordance with the TDG Regulations.

EC Information Request #2

Request: In section 1.1, Current Development Description, and section 1.2 Regulatory Activity summary, the estimated flow rate from gas well A-46 is given as 10 MMcfd (283 $10^3 \times m^3/d$. However, the flow rate for A-46 used in the model predictions is 5 MMcfd (141.6 $10^3 \times m^3/d$) (section 9.3.4, Dispersion Modelling Inputs). Please explain this discrepancy.

Response: In the question, the reviewer has noted that Paramount has plans to operate the A-46 well at the full production capacity (estimated to be 10 MMscf/d

[283×10³×m³/d]). However, during the well testing operations, they only plan to flare at a rate of 5 MMscf/d (141.6×10³×m³/d). Therefore, there is no discrepancy in the report.

EC Information Request #3

Request: Please provide all model input and output electronic files.

Response: This information will provided under separate cover.

EC Information Request #4

Request: The effective or pseudo-height of the stack can have significant effects on model predictions. Please provide the calculations for the total heat release of the flare and the effective height and effective diameter of the flare stack. If a software utility was used in the calculation, such as the Alberta Environment Calculation Sheet for Flares, please provide these files.

Response: For the purposes of dispersion modelling, a series of pseudo stack characteristics must be determined for the flare stack. The pseudo stack parameters allow for the simulation of the unconfined combustion of a flare to be simulated with the ISCST3 dispersion model. The calculation of the required parameters assumes the following:

- the pseudo-height of the flare is equal to the height of the flame tip;
- the plume rise is determined on the basis of the buoyancy flux provided by the heat of combustion;
- the pseudo-diameter of the flare is determined by simultaneously solving the buoyancy flux equation for a stack and a flare;
- the velocity of the flared gas is calculated from the flare diameter and the volume of gas discharged; and
- the flare is assumed to have a pseudo-temperature of 1,000°C.

The following formulation is used to derive the pseudo-height. This is based on the assumption that the flame will be tilted at an angle of 45° from the vertical (U.S. EPA 1992).

$$h_{pseudo} = h_{stack} + \underbrace{4.56\times10^{-3}\times H^{0.478}}_{\text{flame height}}$$

where:

h_{pseudo} = the pseudo-height of the stack (metres)

hstack = *the physical flare stack height (metres)*

H = *the total heat release of the flare (cal/s)*

The buoyancy flux formulation for the flare have been based on the Briggs (1969) formulation, assuming that 55% of the heat released from the flare is radiated into the atmosphere (Leahey and Davies 1984). Recent guidance from Alberta Environment (AENV 2000b) recommends that the flaring calculations should be made assuming that only 25% of the heat released is radiated to the atmosphere. The formulation is as follows:

$$F_{b(flare)} = \frac{g \times Q_H}{\pi \times \rho \times c_p \times T_a}$$

and

$$Q_H = (1 - H_{rad}) \times H$$

where:

$F_{b\ (flare)}$	=	the buoyancy flux from the flare (m^4/s^3)
g	=	gravitational acceleration (m/s^2)
Q_H	=	the sensible heat release rate (cal/s)
H	=	the total heat release of the flare (cal/s)
H_{rad}	=	the fraction of heat lost to radiation (25%)
□	=	the gas density (1,205 g/m^3)
c_p	=	the specific heat of the gas (0.24 cal/K)
T_a	=	the ambient temperature (293 K)

Using the above, it is then possible to determine the pseudo stack parameters required for achieving the same buoyancy flux from a non-flare source. Simultaneously solving the buoyancy flux formula for a point source (Briggs 1975) and the flare buoyancy flux noted above will accomplish this:

$$F_{b(stack)} = F_{b(flare)}$$

or

$$g \times v_s \times d_{pseudo}^2 \times \left(\frac{T_s - T_a}{4 \times T_s} \right) = \frac{g \times (1 - H_{rad}) \times H}{\pi \times \rho \times c_p \times T_a}$$

where:

$F_{b(stack)}$	=	the buoyancy flux of the pseudo stack [m^4/s^3]
g	=	gravitational acceleration [m/s^2]
v_s	=	the release velocity [m/s]
d_{pseudo}	=	the pseudo-diameter of the stack [m]
T_s	=	the release temperature [1,273 K]
T_a	=	the ambient temperature [293 K]

H	=	the total heat release of the flare [cal/s]
□	=	the gas density [1,205 g/m^3]
c_p	=	the specific heat of the gas [0.24 cal/K]
T_a	=	the ambient temperature [293 K]

By rearranging the above formula, it can be simplified in the following manner:

$$d_{pseudo}^2 = \frac{g \times (1 - H_{rad}) \times H \times 4 \times T_s}{\pi \times \rho \times c_p \times T_a \times g \times v_s \times (T_s - T_a)}$$

or

$$d_{pseudo} = 3.829 \times 10^{-3} \sqrt{\frac{H}{v_s}}$$

where:

d_{pseudo}	=	the pseudo-diameter of the stack [m]
H	=	the total heat release of the flare [cal/s]
v_s	=	the release velocity [m/s]

The following table lists the emission characteristics used in evaluating each of the flare stacks.

Pseudo Flare Stack Characteristics Used in the Dispersion Modelling

Parameter	Dispersion Model Inputs	
	Gas Wells	Oil Wells
typical flared gas volume [m^3/d]	141,580	14,158
fraction of C_1 to C_5 [molar %]	89.51	89.51
fraction of C_6^+ [molar %]	0.15	0.15
fraction of H_2S [molar %]	1.70	1.70
lower heating value [MJ/m^3]	32.29	32.29
total heat release [MJ/s]	52.9	5.3
physical height [m]	12.2	12.2
pseudo-height [m][(a)]	23.51	15.96
physical diameter [m]	0.152	0.076
pseudo-diameter [m][(a)]	1.44	0.72
exit velocity [m/s]	89.83	35.93
pseudo-temperature [°C][(a)]	1,000	1,000
SO_2 emission rate [g/s][(b)]	72.69	7.27
H_2S emission rate [g/s][(b)]	0.79	0.08

[(a)] Pseudo parameters were determined in accordance with AENV guidance (2000).

References

AENV. 2000. Air Quality Model Guidelines. Prepared by the Science and Technology Branch. Dated October 2000 and released in November 2000.

Briggs, G.A. 1969. Plume Rise Predictions. In: Lectures on Air Pollution and Environmental Impact Analysis, D.A. Haugen, ed. American Meteorological Society, Boston, Massachusetts, pp. 59-111.

Briggs, G.A. 1975. Plume Rise Predictions. In: Lectures on Air Pollution and Environmental Impact Analysis, D.A. Haugen, ed. American meteorological Society, Boston, Massachusetts, pp. 59-111.

Leahey, D.H. and M.J.E. Davies. 1984. Observations of Plume Rise from Sour Gas Flares. Atmospheric Environment, Volume 18, Number 5, pp. 917-622.

United States Environmental Protection Agency (U.S. EPA). 1992. Screening Procedures for Estimating the Air Quality Impacts of Stationary Sources.

Prepared by the Office of Air Quality Planning and Standards, Research Triangle Park NC. EPA-450/4-88-010.

EC Information Request #5

Request: Within the Cameron Hills study area there are a number of existing oil and gas wells (shown in Figure 3-1 and listed in Table 4-1). What are the emissions from the existing wells? If there are emissions from the existing wells, were they included in the modeling predictions?

Response: The other existing oil and gas wells in the Camaeron Hills study area are not sources of air emissions at this time. These wells are all shut-in or capped and are not releasing compounds to the atmosphere, nor will they be emitting during the well evaluations completed as part of the Cameron Hills Drilling Program.

EC Information Request #6

Request: The proponent should include the following within their Spill contingency Plan:

Ensure that spill kits and containment, adequately address the potential volume of fuel spills.

Ensure that spill contingency plans include contact telephone numbers and specify that all spills must be contained and reported immediately to the NWT Spill Line at (867) 920-8130.

Response: Fuel storage consists of a 1000 USG storage tank for each of gasoline and diesel and a third empty 1000 USG as per regulation, all secondary contained for the total volume. Waste disposal bags for any contaminated soil and any spill kits required for initial mitigation would be kept at the more major facility locations in the area, but readily accessible. As the ERP/ Spill Contigency Plan Manuals are being finalized with all the proposed additions and changes for both Cameron Hills and Fort Liard; the NWT Spill Line number will be included. A copy of this document will be sent to Environment Canada.

Mandell Pinder Information Request #1

Request: Can Paramount now identify the water sources they will be using for drilling?

Response: Please refer to the Environmental Screening Report for the Cameron Hills Drilling Project dated August 2000, Section 5.5 Water Source where this information is provided.

Mandell Pinder Information Request #2

Request: In the Tracking of Consultation included in the report dated November 15, 2000, Paramount identifies concerns raised by Pierre Modeste, an Elder to include the effect on traditional activities in the area which include hunting for moose and fur bearer trapping, including martin, fisher, mink, beaver and lynx. Can Paramount identify the impact of the project on these specific species?

Response: Paramount agrees that the region containing the Cameron Hills Drilling Project supports a mosaic of habitat types that are capable of supporting moose, marten, fisher, mink, beaver and lynx. These species are year-round residents of the region, and they utilize those habitats that meet their life requisites for a particular season. For example, moose typically seek dense tree cover with less snow during the late winter, when food is limited, and travel through deep snow can stress the animals.

To help protect moose and habitat, the crossings of drainages such as the Cameron River, were located at existing crossing locations (e.g., seismic cutlines). The wells are primarily sited in open black spruce vegetation, which is not considered prime habitat for moose, particularly in the late winter. Better habitat for moose was noted on the slopes of the Cameron Hills leading down towards Tathlina Lake and to the Hay River. In these locations, food and cover were more plentiful, and considered to provide good winter habitat for moose. These better habitat areas are away from the drilling project and will not be directly impacted. As the work will be done in the winter, Paramount will leave openings in the snow piles along the access routes (e.g., at game trails and every 500 m) so that a moose could cross the access and not have to jump over any high piles of snow.

Mink and beaver are closely linked to the lakes and rivers in the area that do not freeze to the bottom during the winter. During the wildlife surveys of the access and the potential water source lake, no beaver houses were located in these areas. For the drilling, drainages will be crossed by ice bridges, with the crossings at locations that have been crossed by seismic or drilling equipment in other years. Equipment will not be fueled within 100 m of a wetland or river, which provides protection from inadvertent spills. All equipment will be in good working order and any leaks would be fixed immediately. These measures will limit the potential for water contamination to occur.

Marten and fisher typically utilize older forest cover types that support their food sources. Marten prefer red squirrels, but like the fisher, they will eat small mammals, birds and fruits. The fisher is larger, and typically has a larger home range. The lynx relies heavily on snowshoe hares for food, and as such, lynx populations closely follow the hare population cycle. The lynx prefers forested areas, and regenerating burn areas that support high hare densities. Paramount recognizes that these species are valuable furbearers. Related to trapping, a gap in

the snow pile along the access would be left open at traplines so that snow machines can easily cross.

The overall strategy for the drilling project was to minimize the disturbance to habitat in general, and to limit disturbance to sensitive habitat types. Sensitive habitat types within the region include wetlands, lakes, rivers, and the adjacent uplands. To accomplish this, Paramount routed their access, and located their well leases on or near existing seismic exploration cutlines or winter access trails. In this way, the amount of new cutting of trees, shrubs and disturbance to lichen was localized and minimized. By using the existing clearings, cutlines and access trails, the amount of new habitat fragmentation was minimized.

Workers on the drilling project will not be allowed to hunt, and they will be instructed not to bother wildlife that they might see during the project. Workers will be instructed to stay in the designated work areas so that wildlife that might be in areas close to the project will not be disturbed inadvertently.

With the mitigation plans, and the use of existing cutlines and access trails, the impacts to wildlife are predicted to localized and minimal. Habitat loss and associated habitat fragmentation will be limited, and the primary impact to wildlife is expected to be disturbance from vehicles and human activity. It is anticipated that the animals would distance themselves from the disturbance in the short-term, but become accustomed to the noise over time. The disturbance would only occur over the period of drilling and well evaluation, and would cease once the crews progressed to the next location. The snow plowed access routes may provide easier access for wolves throughout the project area. This potential impact would be expected to last the length of the project, but would be limited in scope, due to the presence of humans and vehicle traffic along these same access routes. The access for humans (e.g., trappers and hunters) to currently remote areas could be increased while the project is ongoing. However, the access has been used in the past, and new access will be limited. These issues are addressed in the August 24, 2000 drilling EIA, and summarized in Table 8, on page 63.

With respect to the well evaluation program, the potential effects to wildlife are related to disturbance (i.e., noise, light) and the potential for exposure to air emissions. These issues are discussed for wildlife (i.e., mammals, birds, amphibians) in Section 9.6.2 in the Environmental Impact Assessment in Response to the Terms of Reference for the Paramount Resources Ltd. Cameron Hills Drilling Project, submitted to the Mackenzie Valley Environmental Impact Review Board in June, 2001.

In summary, because existing clearings at the well locations will be used (i.e., no new clearing), and activity will be restricted to approved locations and access, and because the flaring during well evaluations will adhere to the NWT air quality standards, no residual impacts to wildlife and/or habitat are predicted for the evaluation portion of the program.

Mandell Pinder Information Request #3

Request: In the report dated November 15, 2000, Paramount identifies certain bird species and key habitat bird sites within the general geography embraced by the project. Can paramount identify the effect that the flaring may or will have on bird populations in the area?

Response: The flaring during well evaluations are a protective measure that burns harmful gases, and is an activity that will occur over a short period during the winter months. The environmental effects of this issue have been discussed in detail in the Environmental Impact Assessment in Response to the Terms of Reference for the Paramount Resources Ltd. Cameron Hills Drilling Project, submitted to the Mackenzie Valley Environmental Impact Review Board in June, 2001. The potential impacts to birds would be expected to be related to direct exposure to any air emissions, disturbance, and/or any alteration to the available habitat. The direct exposure to emissions would only relate to birds resident in the area during the winter, and would not include migrating birds. Due to the expected distribution and low densities of birds in the area during the winter, the potential for exposure of these birds to air emissions is considered to be low. The only way for migrating birds to be effected by the flaring during well evaluations, would be if there was any habitat degradation. The NWT air quality standards will be met, which are designed to protect the natural environment. Therefore no effect on vegetation, and therefore no effect to nesting habitat available to migrating or year-round resident birds is predicted.

Year-round resident birds may be impacted by the noise and light generated during the flaring. This impact is expected to be local in extent, short-term in duration, and will cease when the test is complete. Based on the expected low densities of resident birds, and local extent of the disturbance, this impact is considered to be not significant.

We trust that this information meets your information requirements, however, should you require additional information, please contact Shirley Maaskant at (403) 290-3618.

Yours truly,

PARAMOUNT RESOURCES LTD.

S Maaskant

Shirley Maaskant
Regulatory & Community Affairs Coordinator