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January 13, 2013

Clean Environment Commission
Attention: Cathy Jonhson
305-155 Carlton Avenue
Winnipeg, MB R3C 3H8

Dear Ms. Jonhson:

Re: Edit to the evidence of Dr. Schaefer

In discussions with the Commission in December an interest was expressed in seeing a revision to Dr. Schaefer's evidence in order to correctly reflect the data from Table 2D-3 of the terrestrial report. On behalf of CAC MB, we are pleased to provide this information. As compared to Dr. Schaefer's earlier report, this attachment has two changes.

First, the model of future range condition was revised to correctly reflect the data from Table 2D-3. Second, the model was simplified to conduct a random draw, each year for 40 years into the future, based on the actual percentages burned (1979-2008, Table 2D-3), rather than applying a log-normal distribution. Not using the log-normal distribution appears to have provided more conservative results. This is because the log-normal distribution allowed for the possibility of an extreme fire (sometimes very much larger than 5.9%). Drawing randomly from past fire events was simpler (past = guide to the future) and did not allow for events more extreme than those on record.

The new results imply a lower, but still appreciable, level of risk due to fire. It should be noted that Dr. Schaefer's work was based on the original data provided by the KHLP rather than the updated material which shows significantly more disturbed habitat due to fire.

Dr. Schaefer's work reiterates his concern that the KHLP has failed to prospectively model the impact of fire upon habitat. As he points out, "One cannot, in my view, provide a meaningful evaluation of the prospects for caribou habitat without it."

Please find attached Dr. Schaefer's Revised Model of Fire Hazard.

Thank you for your consideration of these comments.

Yours truly,

For: BYRON WILLIAMS
DIRECTOR

BW/ah

Enclosures

Caribou and the Keeyask Generation Project

A revised model of fire hazard

James A. Schaefer
Department of Biology
Trent University
Peterborough, Ontario K9J 7B8
13 December 2013

What are the future prospects for caribou?

I revised the model of future range condition to correctly reflect the data from Table 2D-3 – i.e., the percentages of the total RSA that burned each year (minimum = 0%; maximum = 5.9%).

I also simplified the model to conduct a random draw, each year for 40 years into the future, based on the actual percentages burned (1979-2008, Table 2D-3), rather than applying a log-normal distribution. (The log-normal distribution carried a large degree of uncertainty regarding a large fire [>5.9%], to which the results were very sensitive.) Simply stated, the model uses the recent past as the guide for the near future.

The model was run 1000 times (Table A1). I expressed the output as the likelihood of risk (or greater) as percentiles after 40 years (Figure 1). Not surprisingly, these new results imply a lower, but still appreciable, level of risk due to fire. In particular, after 40 years they indicate:

- 62% likelihood that the range will fall into the Moderate category (or higher). This likelihood is not dramatically lower (just 11% less) than my original estimate – a reflection of the current range condition which, at 33.9% disturbed, is at the very cusp of the Moderate category. Even a few fires would push the range beyond that benchmark.

- 11% likelihood of falling into the High risk category. This is much lower than my previous estimate (29% less), although still considerable.

I reiterate my initial conclusion, that the model implies that "... the Project may occur in the midst of a more disturbed landscape than described in the EIS, with negative repercussions for caribou."

Furthermore, as I have emphasized, it is not the model but the modelling that is crucial. One cannot, in my view, provide a meaningful evaluation of the prospects for caribou habitat without it.

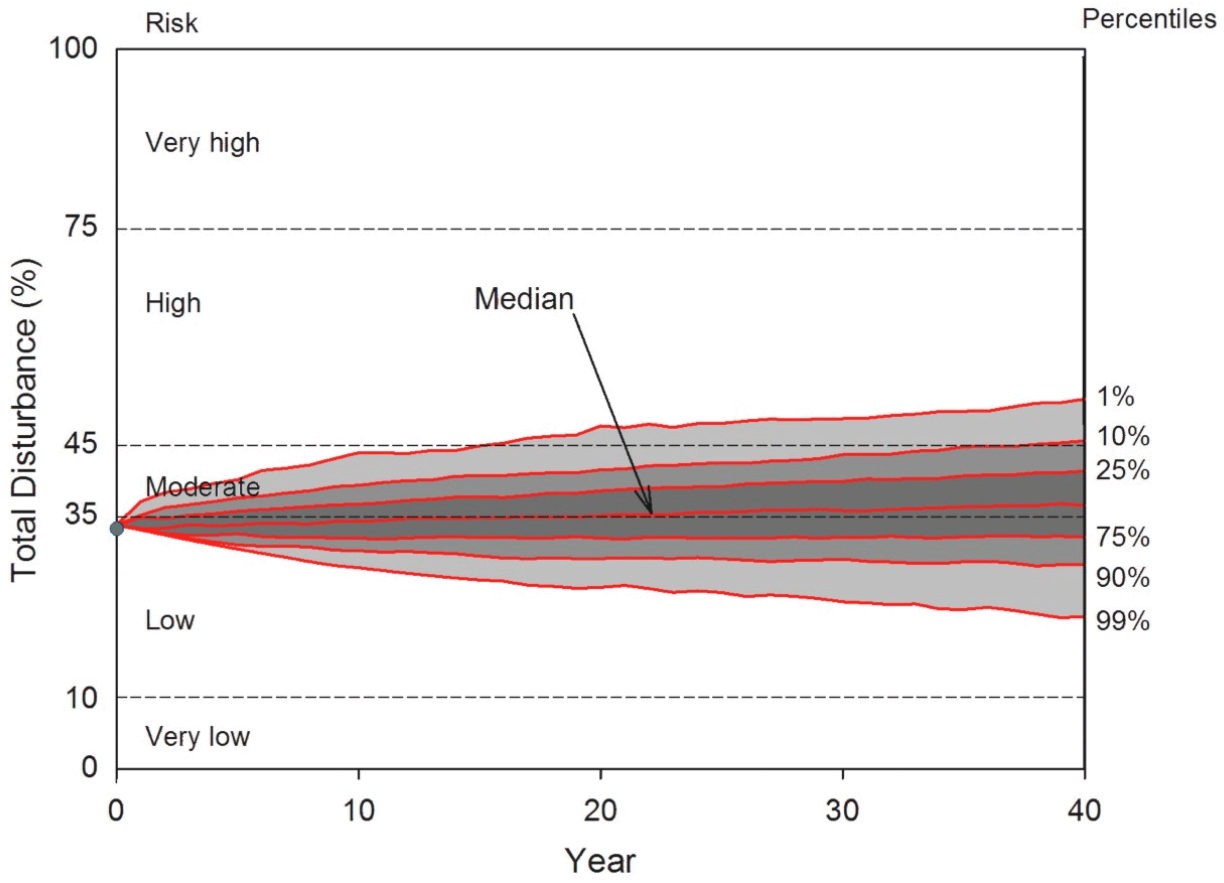

Figure 1. Proportion of the Keeyask Generation Project area disturbed, projected 40 years into the future, based on a revised stochastic model of fire occurrence in Keeyask study area. Risk categories to caribou are from Environment Canada (2011).

Table A1. Revised QB64 Basic program to conduct stochastic modelling of annaul fire occurrence in the Keeyask region.

```
OPEN "F:KEEYASK_INTACT_CORRECT.TXT" FOR OUTPUT AS #1
OPEN "f:KEEYASK_BURNS_CORRECT.TXT" FOR OUTPUT AS #2
PRINT #1, "Z YEAR DISTURBED INTACT BURN"
'PRINT #2, "Z YEAR BURN"
RANDOMIZE (1)
DIM AGE(40)
'Perform multiple simulations
FOR Z = 1 TO 1000
 'The starting age distribution
 AGE(40) = 66.100 '<- AGE 40 YEARS OR MORE
 AGE(0) = 1.030 :  AGE(1) = 1.019 :  AGE(2) = 1.009 :  AGE(3) = 0.998 :  AGE(4) = 0.988 :  AGE(5) = 0.978 :  AGE(6) = 0.968 :  AGE(7) = 0.958 :  AGE(8) = 0.948 :  AGE(9) = 0.938 :  AGE(10) = 0.929 :  AGE(11) = 0.919 :  AGE(12) = 0.910 :  AGE(13) = 0.900 :  AGE(14) = 0.891 :  AGE(15) = 0.882 :  AGE(16) = 0.873 :  AGE(17) = 0.864 :  AGE(18) = 0.855 :  AGE(19) = 0.846 :  AGE(20) = 0.837 :  AGE(21) = 0.829 :  AGE(22) = 0.820 :  AGE(23) = 0.812 :  AGE(24) = 0.803 :  AGE(25) = 0.795 :  AGE(26) = 0.787 :  AGE(27) = 0.779 :  AGE(28) = 0.771 :  AGE(29) = 0.763 :  AGE(30) = 0.755 :  AGE(31) = 0.747 :  AGE(32) = 0.740 :  AGE(33) = 0.732 :  AGE(34) = 0.724 :  AGE(35) = 0.717 :  AGE(36) = 0.710 :  AGE(37) = 0.702 :  AGE(38) = 0.695 :  AGE(39) = 0.688
 'Simulate for 40 years
 FOR YEAR = 0 TO 40
  'Random draw:  Probability distribution of percentage of range burned from lognormal distribution
  REPICK:
  PICK = INT(RND * 30) + 1
  IF PICK = 1 THEN BURN = 5.926 :  IF PICK = 2 THEN BURN = 4.714 :  IF PICK = 3 THEN BURN = 3.562 :  IF PICK = 4 THEN BURN = 3.076 :  IF PICK = 5 THEN BURN = 2.998 :  IF PICK = 6 THEN BURN = 2.995 :  IF PICK = 7 THEN BURN = 2.750 :  IF PICK = 8 THEN BURN = 2.634 :  IF PICK = 9 THEN BURN = 1.381 :  IF PICK = 10 THEN BURN = 1.013 :  IF PICK = 11 THEN BURN = 0.627 :  IF PICK = 12 THEN BURN = 0.548 :  IF PICK = 13 THEN BURN = 0.343 :  IF PICK = 14 THEN BURN = 0.341 :  IF PICK = 15 THEN BURN = 0.309 :  IF PICK = 16 THEN BURN = 0.304 :  IF PICK = 17 THEN BURN = 0.277 :  IF PICK = 18 THEN BURN = 0.133 :  IF PICK = 19 THEN BURN = 0.104 :  IF PICK = 20 THEN BURN = 0.082 :  IF PICK = 21 THEN BURN = 0.069 :  IF PICK = 22 THEN BURN = 0.025 :  IF PICK = 23 THEN BURN = 0.021 :  IF PICK = 24 THEN BURN = 0.017 :  IF PICK = 25 THEN BURN = 0.009 :  IF PICK = 26 THEN BURN = 0.003 :  IF PICK = 27 THEN BURN = 0.002 :  IF PICK = 28 THEN BURN = 0.000 :  IF PICK = 29 THEN BURN = 0.000 :  IF PICK = 30 THEN BURN = 0.000
  IF PICK < 1 OR PICK > 30 THEN STOP
  FOR A = 0 TO 39 '<- Tally the age classes under 40 (= Disturbed %)
  DISTURBED = DISTURBED + AGE(A)
  NEXT A
  PRINT USING " ### #### ##.## ##.## ##.###"; Z; YEAR; DISTURBED; AGE(40); BURN
  PRINT #1, Z; YEAR; DISTURBED; AGE(40); BURN
  DISTURBED = 0
  LOSS = 1 - (BURN / 100) '<- LOSS DUE TO BURN EQUALLY DISTRIBUTED IN EACH AGE CLASS
  'IF BURN > largestBURN THEN largestBURN = BURN
  'IF Z < 20 THEN PRINT #2, Z, YEAR, BURN
  'Increment each age class by 1 year
  AGE(40) = (AGE(40) + AGE(39)) * LOSS :  AGE(39) = AGE(38) * LOSS :  AGE(38) = AGE(37) * LOSS :  AGE(37) = AGE(36) * LOSS :  AGE(36) = AGE(35) * LOSS :  AGE(35) = AGE(34) * LOSS :  AGE(34) = AGE(33) * LOSS :  AGE(33) = AGE(32) * LOSS :  AGE(32) = AGE(31) * LOSS :  AGE(31) = AGE(30) * LOSS :  AGE(30) = AGE(29) * LOSS :  AGE(29) =
```

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AGE(28) * LOSS :   AGE(28) = AGE(27) * LOSS :   AGE(27) = AGE(26) * LOSS :   AGE(26) = AGE(25) * LOSS :   AGE(25) =
AGE(24) * LOSS :   AGE(24) = AGE(23) * LOSS :   AGE(23) = AGE(22) * LOSS :   AGE(22) = AGE(21) * LOSS :   AGE(21) =
AGE(20) * LOSS :   AGE(20) = AGE(19) * LOSS :   AGE(19) = AGE(18) * LOSS :   AGE(18) = AGE(17) * LOSS :   AGE(17) =
AGE(16) * LOSS :   AGE(16) = AGE(15) * LOSS :   AGE(15) = AGE(14) * LOSS :   AGE(14) = AGE(13) * LOSS :   AGE(13) =
AGE(12) * LOSS :   AGE(12) = AGE(11) * LOSS :   AGE(11) = AGE(10) * LOSS :   AGE(10) = AGE(9) * LOSS :   AGE(9) =
AGE(8) * LOSS :   AGE(8) = AGE(7) * LOSS :   AGE(7) = AGE(6) * LOSS :   AGE(6) = AGE(5) * LOSS :   AGE(5) = AGE(4) *
LOSS :   AGE(4) = AGE(3) * LOSS :   AGE(3) = AGE(2) * LOSS :   AGE(2) = AGE(1) * LOSS :   AGE(1) = AGE(0) * LOSS :
AGE(0) = BURN
  NEXT YEAR
  'FOR A = 0 TO 39 '<- Tally the age classes under 40 (= Disturbed %)
  'DISTURBED = DISTURBED + AGE(A)
  'NEXT A
  'PRINT USING " ###  ##.###  ##.##"; Z; DISTURBED; AGE(40)
  'PRINT #1, Z; DISTURBED; AGE(40); largestBURN
  'DISTURBED = 0
  'largestBURN = 0
  SLEEP
NEXT Z
CLOSE
```