November 19, 2012

Susan Whittaker
Natural Resources Conservation Board
4th Floor, Sterling Place
9940 – 106 Street
Edmonton, AB T5K 2N2

Pat Marriott, P. Eng.
District Approvals Manager, Northern Region
and
Camille Almeida
Environmental Assessment Coordinator

Alberta Environment and Sustainable
Resource Development
111 Twin Atria Building
4999 - 98 Avenue
Edmonton, AB T6B 2X3

Dear Madam/Sir:

**Re: Parsons Creek Aggregates Limestone Quarry Project
Clarification Questions of Supplemental Information Request 3 Responses**

Parsons Creek Aggregates (PCA), a joint venture of Graymont Western Canada Inc. (Graymont) and Lehigh Hanson Materials Limited (Lehigh Hanson), has completed and attached the responses to the clarification questions forwarded in your October 24, 2012 email for the proposed Parsons Creek Aggregates Limestone Quarry Project. The application was filed with the Natural Resources Conservation Board (NRCB) (Application No. 1001) and Alberta Environment (EPEA Application No. 002-32302 and Water Act File No. 00269043) on June 8, 2010.

The Project is located on 390 ha of Crown land located 800 m north of the Fort McMurray Urban Service Boundary, south of Northlands Forest Products, east of HWY 63 and along the Athabasca River. The legal land description for the Project is Sections 7, 8, 18, 19, 30, and 31 of Township 90, Range 9 West of the 4th Meridian, and a portion NE¼ Section 36, Township 90, Range 10, West of the 4th Meridian.

Correspondence respecting these applications should be directed to:

Rob Beleutz, AScT, EP(CEA)
Environmental, Health and Safety Manager
Graymont Western Canada Inc.
Telephone: (604) 249-1911
Cellular: (604) 760-2050
Email: rbeleutz@graymont.com

Address: #200 – 10991 Shellbridge Way
Richmond, BC V6X 3C6

With copies sent to:

Derald Starchuk
Principal
Millennium EMS Solutions Ltd.
Telephone: (780) 496-9048
Fax: (780) 496-9049
Email: dstarchuk@mems.ca

Address: #208, 4207 - 98 Street
Edmonton, Alberta T6E 5R7

Sincerely,

Rob Beleutz
Environmental / Safety Manager
Graymont Western Canada Inc.

SIR 4a, Page 3-18

Maximum Points of Impingement for application case scenarios need to be addressed for the LSA to determine project effects.

a. Present a table showing the project related maximum point of impingement in the LSA for Project only, Baseline and Application Case Scenarios.

Clarification:

The response to SIR3 #5 (Table 5-22) included maximum predicted concentrations for all assessment scenarios within the RSA and LSA and at special receptors. These values are summarized as requested for 1-hour periods in Table 4-1.

Table 4-1 Maximum First-Highest LSA Predictions

SO_2 (µg/m^3)	Background	Project	Baseline	Application	PDC	AAAQO
1-hr Concentration (µg/m^3)						
LSA Maximum	7.0	5.8	682	682	682	450
24-hr Concentration (µg/m^3)						
LSA Maximum	5.0	1.7	77	77	77	125
Monthly Concentration (µg/m^3)						
LSA Maximum	4.0	0.54	14.1	14.1	14.5	30
Annual Concentration (µg/m^3)						
LSA Maximum	3.0	0.46	8.2	8.2	8.4	20
NO_x and NO_2 (µg/m^3)	**Background**	**Project**	**Baseline**	**Application**	**PDC**	**AAAQO**
1-hr NO_x Concentration (µg/m^3)						
LSA Maximum	90	2,310	1,982	2,430	3,069	-
1-hr NO_2 Concentration (µg/m^3)						
LSA Maximum	-	199	185	203	226	300
Annual NO_x Concentration (µg/m^3)						
LSA Maximum	19	156	79	192	198	-
Annual NO_2 Concentration (µg/m^3)						
LSA Maximum	-	40	29	44	45	45
CO (µg/m^3)	**Background**	**Project**	**Baseline**	**Application**	**PDC**	**AAAQO**
1-hr Concentration (µg/m^3)						
LSA Maximum	458	3,873	2,783	4,367	4,387	15,000
8-hr Concentration (µg/m^3)						
LSA Maximum	415	1,581	1,459	2,161	2,244	6,000

Table 4-1 Maximum First-Highest LSA Predictions						
$PM_{2.5}$ (µg/m^3)	Background	Project	Baseline	Application	PDC	AAAQO
1-hr Concentration (µg/m^3)						
LSA Maximum	17	103	217	122	170	80
24-hr Concentration (µg/m^3)						
LSA Maximum	7.0	27	43	43	47	30

b. Compare the results of any new or additional dispersion modelling results to health based Toxicity Reference Values (TRVs) and discuss the potential health impact.

Clarification:

A comparison of dispersion modeling results to health based guidelines was provided in response to SIR3 #3. Overall, the predicted concentrations of NO_2, SO_2, and $PM_{2.5}$ for the Application Case were identical to those predicted in the Baseline Case, indicating that the Project emissions are expected to have a negligible impact on predicted health risks.

SIR 4b, Page 3-19

As per the guidance from the Alberta Environment (2009, 2011), The second highest one day (24-hour) average concentration per year **must be** less than the corresponding Ambient Air Quality Objective. Applicant must review the facility design (including pollution control equipment) or develop a management plan implemented through a facility's approval if the modelling results show more than one day per year of exceedance. *This means that all of the first highest predictions are examined at every receptor. If receptor A has the highest first highest 24 hour concentration and receptor B has the second highest first highest concentration then both are presented and if receptor B does not exceed the AAAQO it is acceptable.*

a. Provide the 24 hour (1st Highest) values. If there is any exceedance of the corresponding AAAQO for the 24-hour (1st Highest), provide number of receptors exceeding the AAAQO and the frequency of exceedance at each of these receptors.

Clarification:

The complete guidance on 24-hour exceedances is as follows from ESRD 2011 (Section 4.2, p. 7): "The second highest one day (24-hour) average concentration per year must be less than the corresponding Ambient Air Quality Objective. The applicant must review the facility design (including pollution control equipment) or develop a management plan implemented through a facility's approval if the modelling results show more than one day per year of exceedance."

Tables 9.8 to 9.12 in the response to SIR2 #9 list the model predictions including 24-hour averages for SO_2 and $PM_{2.5}$. There are no maximum 2nd highest SO_2 predictions above ambient objectives. According to the response to SIR2 #9, "24-hour average $PM_{2.5}$ concentrations were above the AAAQO at both RSA and LSA MPOIs in all emissions scenarios, where the Project influence was negligible to small." In particular, at the LSA MPOI, the Project contribution was only 1 µg/m3, while the maximum Project contribution, which occurred at the Project fenceline, was 24 µg/m^3.

Table 4-2 summarizes the maximum predicted concentration, maximum frequency of exceedance of the 24-h objective for $PM_{2.5}$, as well as number of receptors with exceedance for 1^{st} and 2^{nd} highest $PM_{2.5}$ predictions in LSA. This table indicates that exceedances occurred on more than one day each year at a number of receptor locations.

Table 4-2 Predicted 24-hour Concentrations and Exceedance in LSA

Parameter	Background	Baseline	Application	PDC	AAAQO*
24-hr Maximum $PM_{2.5}$ Concentration					
LSA Maximum (µg/m^3)	7	43	43	47	30
Max Frequency of the exceedance	-	12	16	21	-
number of receptors with exceedance	-	168	209	735	-
24-hr 2^{nd} Highest $PM_{2.5}$ Concentration					
LSA Maximum (µg/m^3)	7	39	40	43	30
Max Frequency of the exceedance	-	11	15	20	-
number of receptors with exceedance	-	78	99	328	-

Figures 4-1 to 4-3 plot the frequency of 24-h $PM_{2.5}$ exceedance at each receptor in the LSA for Baseline, Application and PDC cases, respectively. The figures also show the 2^{nd} highest $PM_{2.5}$ concentration contour for 30 µg/m^3. The figures show:

- In the Baseline case, exceedances are predicted on the fenceline as a result of current gravel operations. These operations cease when Project operations start. Also shown are exceedances associated with urban emissions in the suburb of Fort McMurray.
- In the Application case, exceedances are predicted at and just outside the southwestern fenceline associated with pit activities.
- In the PDC case, additional exceedances were predicted as a result of modelled growth in oilsands industry, traffic and urban emissions.

In response to the model predictions, which indicated that exceedances occurred more than one day per year at the LSA MPOI, and as required by ESRD (2011), PCA developed a particulate/dust management plan, which is summarized in the response to SIR1 #46e. Thus, PCA believes it has fully met the requirement of the guidance provided by ESRD (2011). PCA intends to monitor particulate as part of its dust management plan and will develop adaptive responses as appropriate.

References:

Alberta Environment and Sustainable Resource Development (ESRD). 2011. *Using Ambient Air Quality Objectives in Industrial Dispersion Modelling and Individual Industrial Site Monitoring* (Revision of 2009. 24 hour interpretation is the same).

Alberta Environment and Sustainable Resource Development (ESRD). 2009. *Using Ambient Air Quality Objectives in Industrial Dispersion Modelling and Individual Industrial Site Monitoring*

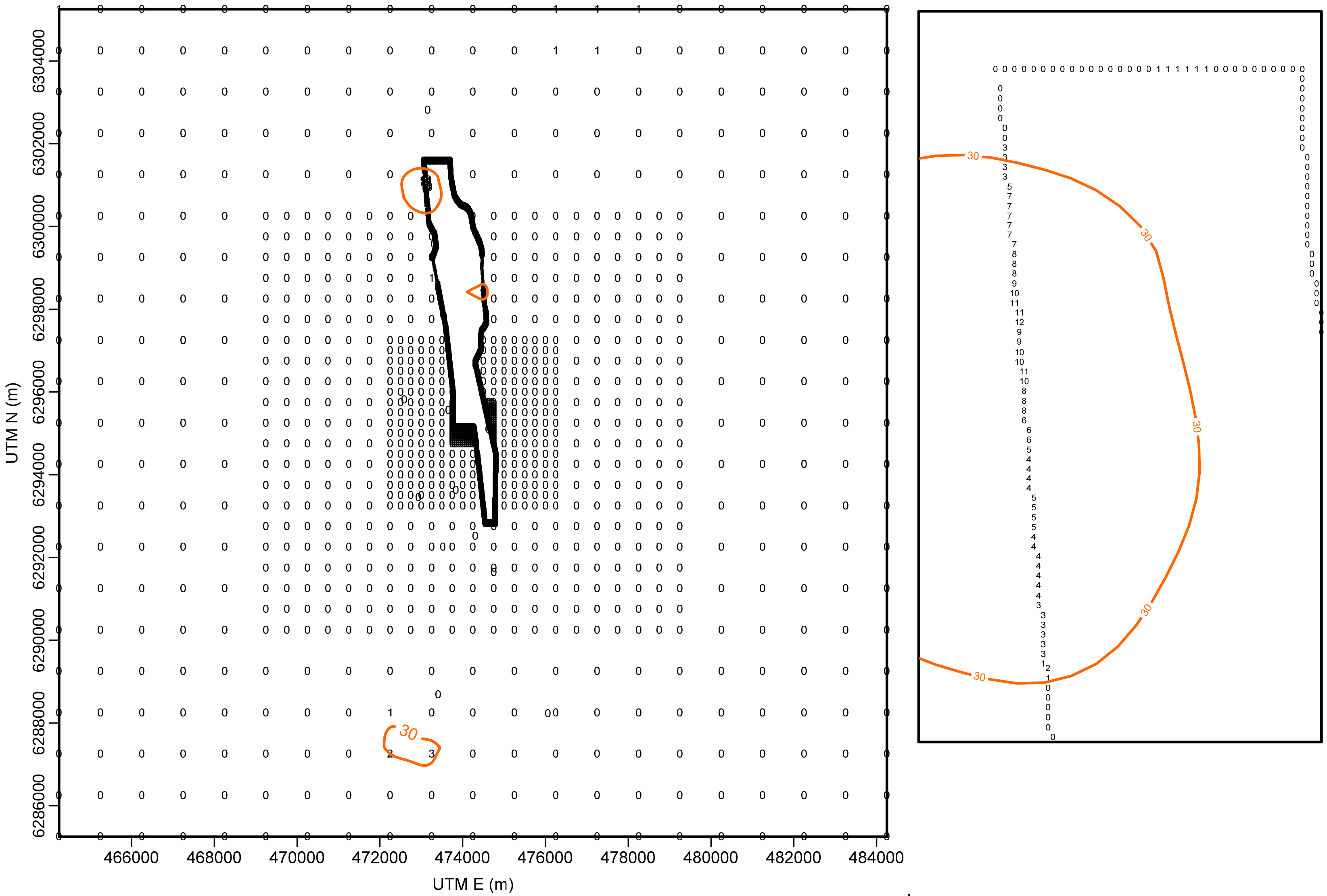


Figure 4-1 Frequency Distribution of Maximum 24-hour $PM_{2.5}$ Exceedance and 2nd Highest 24-hour $PM_{2.5}$ Isopleth - Baseline

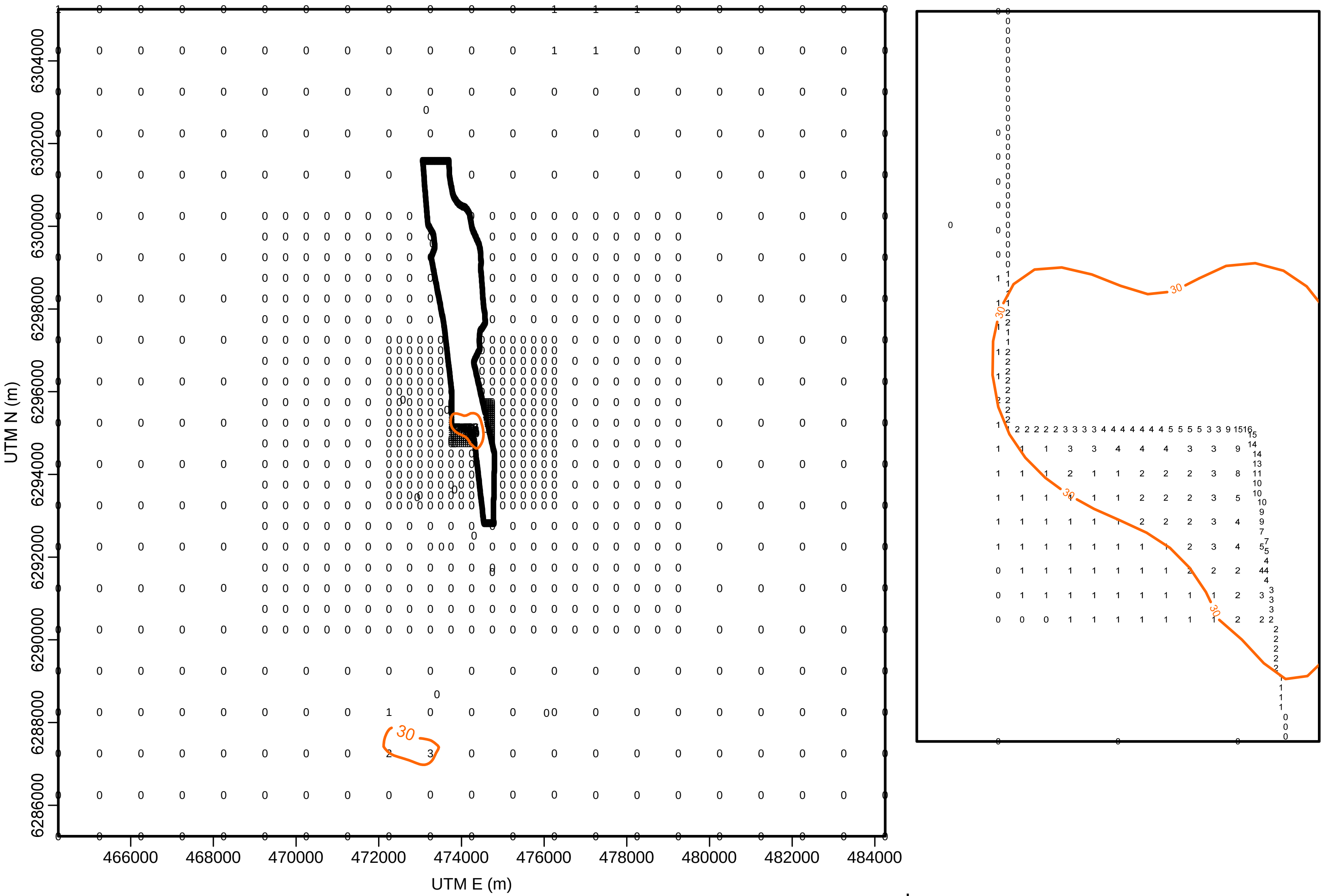


Figure 4-2 Frequency Distribution of Maximum 24-hour $PM_{2.5}$ Exceedance and 2nd Highest 24-hour $PM_{2.5}$ Isopleth - Application

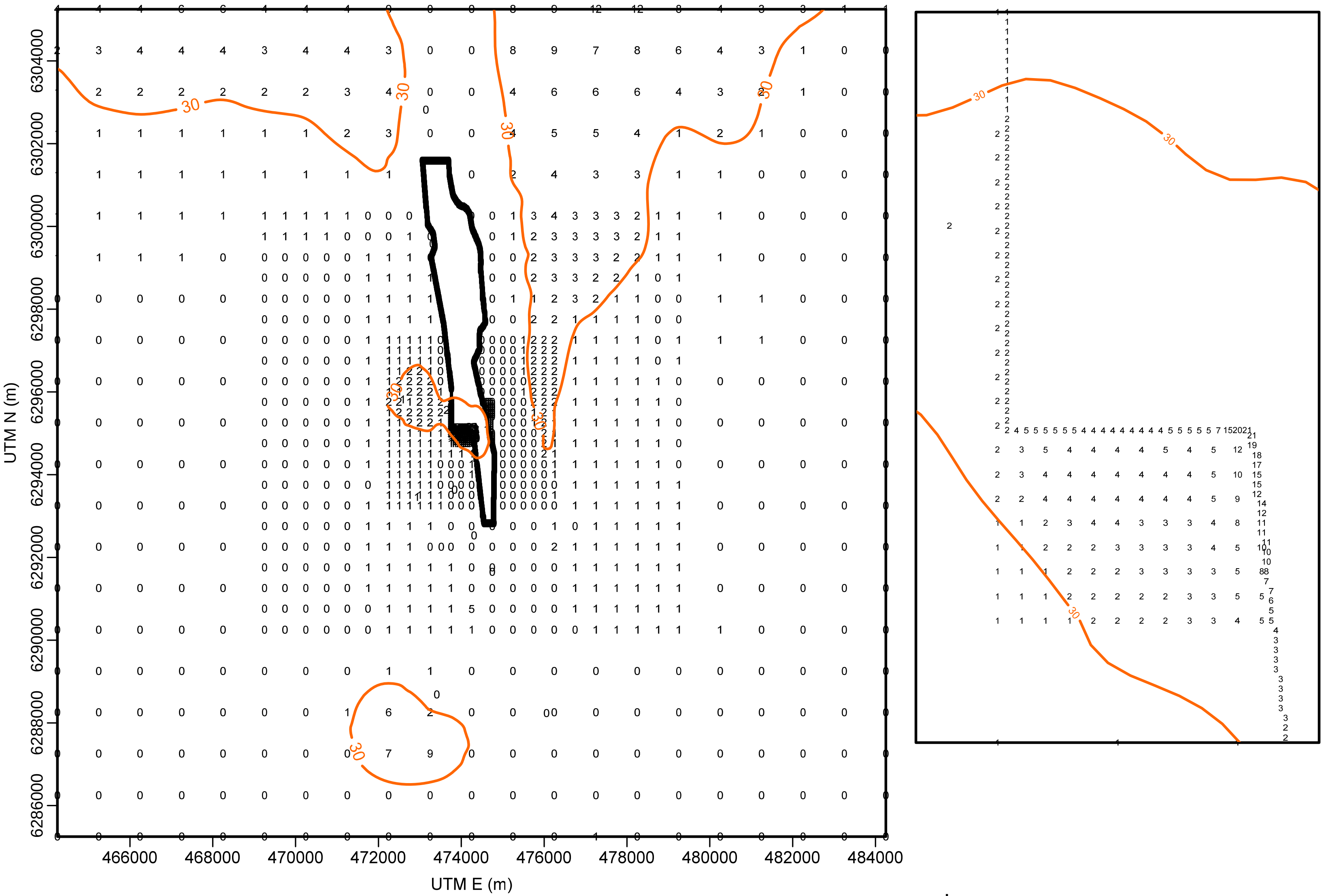


Figure 4-3 Frequency Distribution of Maximum 24-hour $PM_{2.5}$ Exceedance and 2nd Highest 24-hour $PM_{2.5}$ Isopleth - PDC

SIR 5a, Page 3-20

The following are questions in response to the data presented:

a. Calculate NO_2 using the Ozone Limiting Method.

Clarification:

Table 5-1 lists model predictions of NO_x and NO_2 concentrations calculated using the Ozone Limiting Method (OLM) and compares them to AAAQOs.

Guidance on the OLM in the ESRD modelling guideline (ESRD 2009) states that if the ambient ozone concentration is greater than 90% of the predicted NO_X, then it is assumed that all the NO_X is converted to NO_2. Otherwise, the NO_2 concentration is equal to the sum of the ozone and 10% of the predicted NO_X concentration.

That is: if $[O_3] > 0.9\ [NO_X]$, then $[NO_2] = [NO_X]$

Otherwise, $[NO_2] = [O_3] + 0.1\ [NO_X]$

As emissions were first modelled as NO_2 and NO, predicted NO_2 concentrations were then calculated from molar addition of NO_2 and NO using the OLM method. Background NO_x concentrations were included.

In this approach, the observed hourly O_3 ambient concentrations from the Fort McMurray Athabasca Valley monitoring station were used in the NO_2 conversion calculations as it was the closest station to the Project that collected ambient O_3 measurements.

The table indicates:

- Predicted hourly and annual NO_2 concentrations at RSA MPOIs exceeded the AAAQOs for all scenarios, while the Project contributions above Baseline predictions were negligible.
- At the LSA MPOI, fenceline and sensitive receptors, predicted 99.9^{th} percentile 1-hour NO_2 concentrations were lower than the AAAQO for all scenarios, while the annual maximum exceeded the AAAQO of 45 µg/m^3 for Application and PDC scenarios.
- Modelling predicted Project contributions of 43% and 83% for 99.9^{th} percentile 1-hour NO_2 concentrations at the LSA MPOI and fenceline, respectively, and about 52% Project contribution for annual NO_2.

The OLM predictions presented here (other OLM approaches are shown in the response to part c) of this clarification), are alternatives to the ARM predictions on which the assessment is based. They do not replace or invalidate the predictions using the ARM method and are presented for comparison only.

Table 5-1 Summary of Predicted NO_x Concentrations and NO_2 Concentrations Using OLM Method

NO_x and NO_2 ($\mu g/m^3$)	Background	Baseline	Application	PDC	AAAQO
Maximum 1-hr NO_x Concentration ($\mu g/m^3$)					
Overall Maximum (MPOI)	90	6,934	6,934	6,661	-
LSA Maximum	90	1,982	2,430	3,069	-
Maximum at Fenceline	90	1,453	2,430	2,445	-
Maximum at Residences	90	944	1,605	1,629	-
Maximum 1-hr NO_2 Concentration ($\mu g/m^3$)					
Overall Maximum (MPOI)		1,026	1,026	938	-
LSA Maximum		256	349	363	-
Maximum at Fenceline		221	349	352	-
Maximum at Residences		129	265	267	-
99.9% 1-hr NO_x Concentration ($\mu g/m^3$)					
Overall Maximum (MPOI)	90	4,780	4,780	4,963	-
LSA Maximum	90	1,378	1,665	1,762	-
Maximum at Fenceline	90	893	1,665	1,670	-
Maximum at Residences	90	579	1,114	1,130	-
99.9% 1-hr NO_2 Concentration ($\mu g/m^3$)					
Overall Maximum (MPOI)		727	727	689	300
LSA Maximum		185	266	267	300
Maximum at Fenceline		145	266	267	300
Maximum at Residences		113	172	179	300
Annual NO_x Concentration ($\mu g/m^3$)					
Overall Maximum (MPOI)	19	313	313	390	-
LSA Maximum	19	79	192	198	-
Maximum at Fenceline	19	79	192	198	-
Maximum at Residences	19	49	72	78	-
Annual NO_2 Concentration ($\mu g/m^3$)					
Overall Maximum (MPOI)		71	71	83	45
LSA Maximum		39	59	60	45
Maximum at Fenceline		39	59	60	45
Maximum at Residences		28	34	35	45

- No AAAQO for this parameter

References:

Alberta Environment and Sustainable Resource Development (ESRD). 2009. Air quality model guideline. Prepared by A. Idriss and F. Spurrell. Science and Standards Branch. http://www3.gov.ab.ca/env/air/airqual/airmodelling.html. 44 pp.

b. *Receptor grid spacing did not meet AQMG 2003 as per the TOR. Update the modelling to comply with the model guide.*

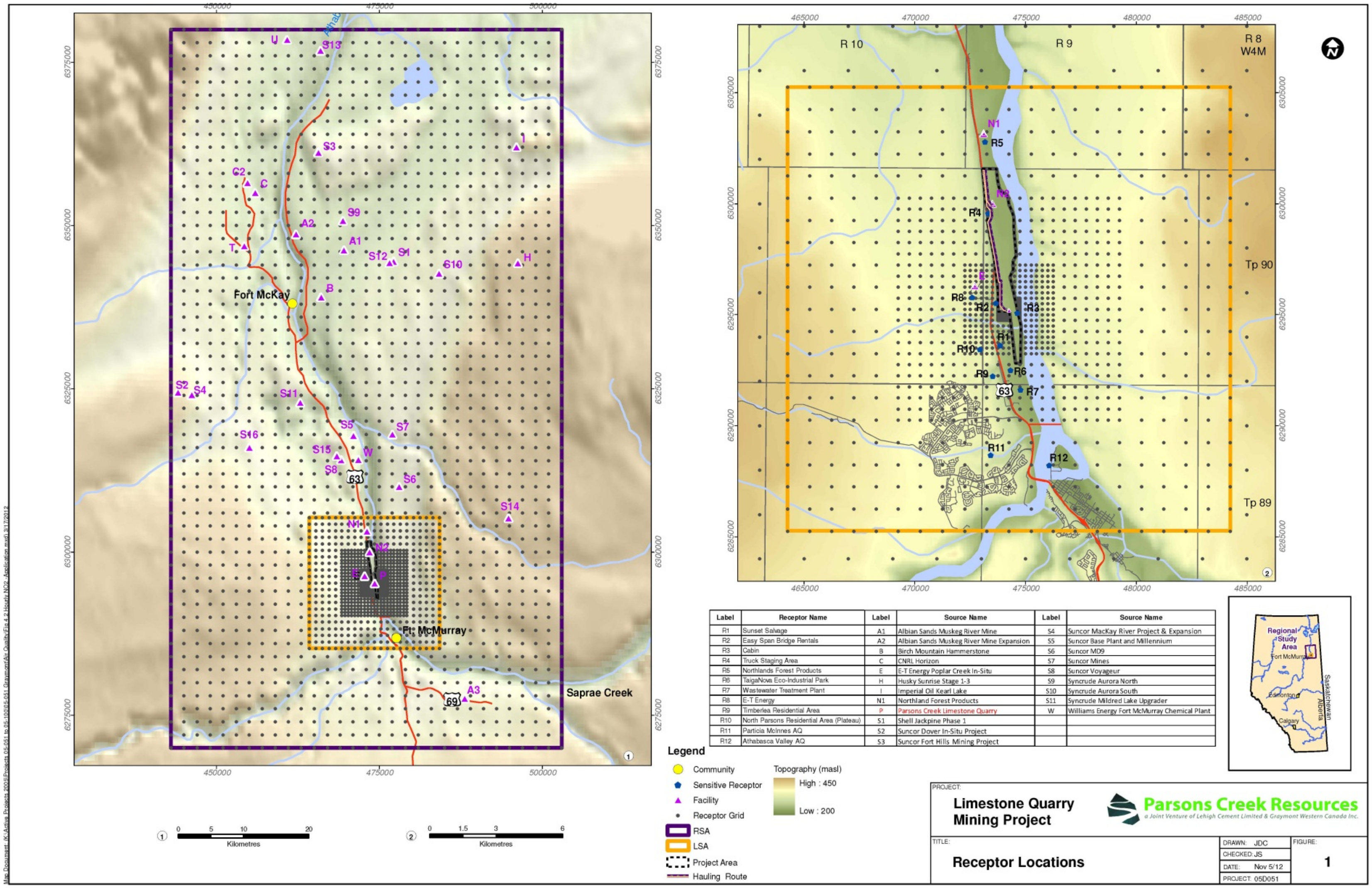
Clarification:

The response to SIR2 #9 identifies the receptor spacing using in modelling. The following is taken from that response. The receptor spacing meets the ESRD/AEW (2009) model guidance:

"The receptor grids described below were used as per AEW (2009). Receptor grids were set according to the following spacing:

- Grid A = 20 m spacing along the Project boundary
- Grid B =1 x 1 km, 50 m spacing, centred on 474250 m E, 6295250 m N;
- Grid C = 4 x 4 km, 250 m spacing, centred on 474250 m E, 6295250 m N;
- Grid D = 10 x 10 km, 500 m spacing, centred on 474250 m E, 6295250 m N;
- Grid E = 20 X 20 km, 1000 m spacing, centred on 474250 m E, 6295250 m N;
- Grid F = 60 X 110 km, 2000 m spacing beyond 10 km from the Project
- 12 sensitive receptors."

Figure 5-1 shows the locations of all receptors used in modeling. PCA also notes that the wording in the response to SIR2 #9 suggests that predictions were made outside the fenceline while in fact predictions were made on and outside the fenceline, and the higher value was reported.



Label	Receptor Name	Label	Source Name	Label	Source Name
R1	Sunset Salvage	A1	Albian Sands Muskeg River Mine	S4	Suncor MacKay River Project & Expansion
R2	Easy Span Bridge Rentals	A2	Albian Sands Muskeg River Mine Expansion	S5	Suncor Base Plant and Millennium
R3	Cabin	B	Birch Mountain Hammerstone	S6	Suncor MD9
R4	Truck Staging Area	C	CNRL Horizon	S7	Suncor Mines
R5	Northlands Forest Products	E	E-T Energy Poplar Creek In-Situ	S8	Suncor Voyageur
R6	TaigaNova Eco-Industrial Park	H	Husky Sunrise Stage 1-3	S9	Syncrude Aurora North
R7	Wastewater Treatment Plant	I	Imperial Oil Kearl Lake	S10	Syncrude Aurora South
R8	E-T Energy	N1	Northland Forest Products	S11	Syncrude Mildred Lake Upgrader
R9	Timberlea Residential Area	P	Parsons Creek Limestone Quarry	W	Williams Energy Fort McMurray Chemical Plant
R10	North Parsons Residential Area (Plateau)	S1	Shell Jackpine Phase 1		
R11	Particia McInnes AQ	S2	Suncor Dover In-Situ Project		
R12	Athabasca Valley AQ	S3	Suncor Fort Hills Mining Project		

c. NO and NO2 cannot be added directly. Recalculate for OLM/TCM and molar addition of NO and NO2. Revise all the model predictions and the EIA to reflect this recalculation.

Clarification:

In the Ambient Ratio Method (ARM) used in the assessment, NO and NO_2 can be added to form NO_X because the concentrations are mass based. The mass of NO_X is the sum of its constituents. The ratio of concentrations is also based on the mass of its constituents, and the application of a predicted NO_X concentration to determine the NO_2 concentration is therefore strictly a statistical comparison.

PCA also notes that the ambient ratio method used in the assessment is consistent with the approach now being rolled out to all modellers as part of the updated air quality model guidelines (*e.g*. ESRD presented the new approach on November 7, 2012 in Calgary). In this new approach, no prior approval is required for the method to be used and the ratio is to be based on measurements within about 80 km of the project site – a condition which applies to the current project which uses data from the oil sands area.

PCA agrees that when the OLM method is used, as presented in the response to part a) above, the molar approach is the correct approach.

PCA stands by the NO_2 predictions using the ARM technique as presented in the assessment. Nonetheless, to address the question, Table 5-2 compares for NO_2 predictions using several NO_x to NO_2 conversion methods. When applying the OLM to calculate NO_2, three groups of O_3 background concentrations were used for comparison:

- Hourly O_3 measurements (2002-2006) at Fort McMurray
- Hourly O_3 measurements (2002-2006) at Fort McKay
- Default O_3 values from ESRD Modelling Guideline (0.050 ppm for hourly average and 0.035 ppm for annual average)

The table indicates that the NO_2 predictions are similar if using OLM with hourly O_3 measurements from Fort McMurray and Fort McKay. The NO_2 concentrations calculated using OLM with default O_3 values from ESRD modelling guideline are the most conservative predictions.

Table 5-3 compares NO_2 measurements to Baseline model predictions at three WBEA stations. The results show that all NO_2 predictions are higher than observations at Fort McKay, which is located in an industrial area. NO_2 ARM predictions are similar to the measurements at Patricia McInnes, the station location nearest to Project operations. NO_2 OLM predictions are similar to measurements at Athabasca Valley but over-predicted observations at Patricia McInnes.

Table 5-2 Comparison of NO_2 Predictions with Difference NO_x to NO_2 Conversion Methods

Method	Ambient Ratio Method (ARM)			OLM with Hourly O_3 from Fort McMurray			OLM with Hourly O_3 from Fort McKay			OLM with Default O_3 Values from ESRD Modelling Guideline		
Scenario	**Baseline**	**Application**	**PDC**	**Baseline**	**Application**	**PDC**	**Baseline**	**Application**	**PDC**	**Baseline**	**Application**	**PDC**
Maximum 1-hr NO_2 Concentration ($\mu g/m^3$)												
Overall Maximum	326	326	321	1,026	1,026	938	1,036	1,036	958	1,104	1,104	1,004
LSA Maximum	185	203	226	256	349	363	258	361	365	334	429	441
Fenceline Maximum	161	203	204	221	349	352	229	361	361	298	429	431
Maximum at Residences	133	169	170	129	265	267	139	269	272	203	310	312
99.9% 1-hr NO_2 Concentration ($\mu g/m^3$)												
Overall Maximum	276	276	281	727	727	689	724	724	708	796	796	756
LSA Maximum	157	171	176	185	266	267	193	261	262	249	326	326
Fenceline Maximum	129	171	172	145	266	267	162	261	262	216	326	326
Maximum at Residences	106	143	144	113	172	179	110	190	191	163	246	248
Annual NO_2 Concentration ($\mu g/m^3$)												
Overall Maximum	55	55	61	71	71	83	72	72	83	107	107	116
LSA Maximum	29	44	45	39	59	60	40	60	60	75	91	92
Fenceline Maximum	29	44	45	39	59	60	40	60	60	75	91	92
Maximum at Residences	23	28	29	28	34	35	30	35	36	53	74	75

Table 5-3 Comparison of NO_2 Baseline Predictions vs. Observations ($\mu g/m^3$) at Three WBEA Monitoring Stations

	Observations*					Baseline Predictions				
	2007	2008	2009	2010	2011	Ambient Ratio Method (ARM)	OLM with Hourly O_3 from Fort McMurray	OLM with Hourly O_3 from Fort McKay	OLM with Default O_3 Values from ESRD Modelling Guideline	Total Conversion Method (TCM)
Fort McMurray - Athabasca Valley										
Maximum 1-hr NO_2	100	149	113	134	122	102	115	103	147	529
99.9% 1-hr NO_2	86	104	88	105	94	80	103	101	126	310
Annual NO_2	18	19	20	21	21	20	23	25	35	34
Fort McMurray - Patricia McInnes										
Maximum 1-hr NO_2	79	73	83	73	85	91	120	111	136	410
99.9% 1-hr NO_2	68	70	70	64	73	84	113	106	130	345
Annual NO_2	11	12	11	11	12	22	27	29	47	43
Fort McKay										
Maximum 1-hr NO_2	88	87	79	87	96	188	278	284	362	2039
99.9% 1-hr NO_2	75	71	70	71	77	156	182	194	246	1347
Annual NO_2	12	13	12	13	12	30	35	36	75	157

*Data source: Clean Air Strategic Alliance (CASA) Data Warehouse [Online]. Available at: http://www.casadata.org/Reports/SelectCategory.asp

d. *Predictions were made outside the project fenceline. Fenceline predictions must be reported. Provide the updated fenceline predictions.*

Clarification:

The response to b) notes that predictions were in fact made on or outside the fenceline, and the higher value was reported. Table 5-4 lists the fenceline predictions. Most LSA maximum were in fact on the fenceline, as noted by comparison to Tables 9.8 to 9.12 in the response to SIR2 #9.

Table 5-4 Maximum First-Highest Predictions on the Project Fenceline

SO_2 (µg/m³)	Background	Project	Baseline	Application	PDC	AAAQO
1-hr Concentration (µg/m³)						
Fenceline Maximum	7.0	5.8	115	115	116	450
24-hr Concentration (µg/m³)						
Fenceline Maximum	5.0	1.7	40	40	40	125
Monthly Concentration (µg/m³)						
Fenceline Maximum	4.0	0.54	10.7	10.7	10.9	30
Annual Concentration (µg/m³)						
Fenceline Maximum	3.0	0.46	6.1	6.1	6.2	20
NO_x and NO_2 (µg/m³)	**Background**	**Project**	**Baseline**	**Application**	**PDC**	**AAAQO**
1-hr NO_x Concentration (µg/m³)						
Fenceline Maximum	90	2,310	1,453	2,430	2,445	
1-hr NO_2 Concentration (µg/m³)						
Fenceline Maximum	-	199	161	203	204	300
Annual NO_x Concentration (µg/m³)						
Fenceline Maximum	19	156	79	192	198	-
Annual NO_2 Concentration (µg/m³)						
Fenceline Maximum	-	40	29	44	45	45
CO (µg/m³)	**Background**	**Project**	**Baseline**	**Application**	**PDC**	**AAAQO**
1-hr Concentration (µg/m³)						
Fenceline Maximum	458	3,873	2,399	4,367	4,387	15000
8-hr Concentration (µg/m³)						
Fenceline Maximum	415	1,581	1,166	2,161	2,244	6000
$PM_{2.5}$ (µg/m³)	**Background**	**Project**	**Baseline**	**Application**	**PDC**	**AAAQO**
1-hr Concentration (µg/m³)						
Fenceline Maximum	17	103	217	122	123	80
24-hr Concentration (µg/m³)						
Fenceline Maximum	7.0	27	43	43	47	30

e. Provide justification of the model options that deviate from regulatory defaults.

Clarification:

The response to SIR3 #5 provided a complete listing of the options used in modelling. The response also identified in table form each model option, its default value, the value used in modelling, and comments or a description of the option. In the text of the response, the rationale was provided for each non-default values used.

For example, in the description of the use of non-defaults in Table 5-2 (in the response to SIR3 #5) which presents wind field options, the following was provided:

"The following provides rationale for the use of non-default model parameters:

- IPROG: MM5 data were used
- FEXTR2: there is no extrapolation – this option is used only when IEXTRP = 3 or -3, whereas IEXTRP = -4 was used in the project
- ISURFT: the 2-D spatially varying surface temperature data is not available for this area
- ICLOUD: gridded cloud cover from prognostic relative humidity at all levels (MM5toGrads algorithm). Since MM5 data was used this is the best option for the model to be used."

Thus PCA understands it has already complied with the request for justification of each of the non-default model options.

f. Winter with snow cover and without snow cover can have influence on the surface properties. How is snow cover accounted for in the CALMET modelling?

Clarification:

The response to SIR3 #5 identified the winter season as the period from November 15 to March 31. Table 5-6 in the same response lists the surface variables use d in modelling as a function of land use. The winter-period values are indicative of snow cover while the fall values (September 15 – Nov 14) and spring values (April 1 – June 14) are indicative of a largely snow-free surface without substantial vegetative activity (little leaf cover).

According to Environment Canada data for Fort McMurray (http://www.climate.weatheroffice.gc.ca/climate_normals/results_e.html?stnID=2519&lang=e&dCode=1&StationName=FORT&SearchType=BeginsWith&province=ALL&provBut=&month1=0&month2=12), the average snow depth on the ground at the end of March is usually 29 cm and the average snow depth at the end of October is 2 cm. Thus, the entire winter season in the oil sands near Fort McMurray is characterized by snow cover, consistent with the modelling approach.

g. *Provide justification of assumed anthropogenic heat flux values for Fort McMurray and open mine surfaces.*

Clarification:

The anthropogenic heat flux can usually be neglected (set equal to zero) in areas outside highly urbanized locations. However, in areas with high population densities or high energy use, this flux may not always be negligible (U.S. EPA 1999).

According to Table 5-6 in the response to SIR3 #5, the seasonal heat flux in Fort McMurray ranged from 10-30 W/m^2. U.S. EPA (1999) indicates the values in high energy use, northern climates range from 13-92 W/m^2 (Montreal) while it was 18 W/m^2 as an annual average in Fairbanks. Because the population density in Montreal is much higher than Fort McMurray, the Fairbanks value is expected to be more appropriate. Therefore, the Fort McMurray value was rounded to 20 W/m^2 and seasonal variation given by a range of 10 W/m^2 around this value.

According to Table 5-6 in the response to SIR3 #5, the anthropogenic heat flux in oil sands mine pits, a region of high energy use, was fixed at 5 W/m^2. Typically, gravel pits and quarries are considered barren land with a negligible heat flux. However, in the case of oil sands pits, the value was increased slightly to account for the high energy use activities including the mine fleet.

Reference:

U.S. EPA. 1999. PCCRAMMET User Guide.
http://www.epa.gov/ttn/scram/userg/relat/pcramtd.pdf

h. *Provide the reference for the statement* The recognition of CALPUFF's tendency to overestimate the rate of nitrogen transformation to NO_2. *This has been compensated for in the ground level NO_2 concentration calculations by using the ARM.*

Clarification:

Exponent. 2012. CALPUFF Training Course, Edmonton, Alberta, Canada, May 7-12, 2012.