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MEMORANDUM

To: Gerald Dilley, Denver Regional Air Quality Council

Cc: Kevin Briggs, Colorado Department of Health and Environment

From: Ralph Morris and Edward Tai, ENVIRON
Dennis McNally, Alpine Geophysics

Date: November 28, 2007

Subject: Response to Comments on the preliminary draft Modeling Protocol for 8-hour ozone modeling of the Denver area dated October 23, 2007

INTRODUCTION

ENVIRON International Corporation and Alpine Geophysics, LLC prepared a preliminary draft Modeling Protocol for performing 8-hour ozone attainment demonstration modeling of the Denver area that was dated October 23, 2007 and is available on the Denver Regional Air Quality Control (RAQC) website:

http://www.ozoneaware.org/documents/Denver03_PreliminaryDraftReport.pdf

A Modeling Protocol meeting was held at RAQC's office in Denver, Colorado on October 25, 2007 with local, state and federal agencies, stakeholders and other interested parties to present the proposed approach in the Modeling Protocol and answer any questions. At this meeting comments on the preliminary draft Modeling Protocol were requested to be submitted in writing to the RAQC by November 7, 2007. RAQC compiled the comments and forwarded them to the ENVIRON/Alpine Team. Comments were received from five separate groups, although the comments from the RAQC and Colorado Department of Health and Environment (CDPHE) Air Pollution Control Division (APCD) were combined into one submission. The four groups that submitted comments were as follows:

- The RAQC and CDPHE/APCD submitted a MSWORD version of the preliminary draft Modeling Protocol using the Track Changes feature for edits and embedding comments in the text of the Modeling Protocol.
- EPA Region 8 submitted comments by e-mail.
- Comments from Noble Energy, Inc and Colorado Oil and Gas Association (COGA) were submitted in a letter dated November 9, 2007 to the RAQC from John R. Jacus of Davis Graham and Stubbs LLP representing Noble and Kenneth A. Wonstolen of Fulbright & Jaworski LLP representing COGA.
- Comments from Patty Stulp of ERAS, Inc. were submitted in a memorandum dated November 9, 2007.

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RESPONSE TO COMMENTS ON PRELIMINARY DRAFT MODELING PROTOCOL

Comments from RAQC and CDPHE/APCD

The comments from the RAQC and the CDPHE/APCD were submitted as Track Changes in the preliminary draft Modeling Protocol MSWORD document that also included a few embedded questions and comments. The Track Changes were mainly editorial or clarifications so after reviewing each one they were accepted. Questions asked and comments were as follows:

Asked for more clarification on how the CAMx runs would be quality assured (QA) in Section 1.5.5: Text was added discussing how multiple people would review the CAMx job control scripts and control files to make sure correct options and inputs are used.

Commented that Section 1.6 Project Participants and Contacts was redundant with Section 1.1: Left Section 1.6 intact since it had contact information not contained in Section 1.1 and there was only one paragraph with redundancy.

In Section 2.1.1 asked whether the MEGAN biogenic emissions model has ever been used for SIP modeling: Added text about newness of MEGAN and additional work where we would also generate biogenic emissions using the GloBEIS model that has been used for SIP modeling and examine sensitivity of the modeling to biogenic emissions.

Comment that reference to Table 4-2 as containing ozone monitoring locations in Section 3.2.1 was incorrect: Corrected reference to Table 4-5.

Requested that ozone values for RMNP be added to Table 3-1: Added Rocky Mountain National Park fourth highest ozone values to Table 3-1.

In section 3.2.4 requested more explanation of ozone data presented in Figures 3-3a through 3-3f: Added text to explain these figures better.

In Section 4.1 asked to better define what is meant by “Actual” and “Typical” emission inventories with request repeated in Section 5.2.1: Added a paragraph explaining the difference between the 2006 Actual and Typical base case emissions inventories to the beginning of Section 5.2.1.

Section 5.2.3 asked to spell out GREASD PiG and IRON PiG acronyms: Acronyms were spelled out.

Asked how the global model species will be mapped to CB05 species in Section 5.3.1: Added text here about availability of MOZART global chemistry model output for 2006 and how it would be mapped to the CAMx grid and CB05 species.

In Section 6.0 asked how we can be assured that the correct emission inventories are being used: ENVIRON/Alpine have developed a set of QA/QC procedures for these types of large modeling studies that include multiple reviews of job scripts and inputs to assure modeling is done correctly. Even with these multi-layers of QA/QC, mistakes do occur and the challenge is to find them and correct before the model simulations. One of the objectives of having multiple people

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review the CAMx run scripts prior to the simulations is to assure that the proper emission file names are being assessed.

In Section 6.1.2 they note that it is their understanding that there is no budget to apply the DDM and PA Probing Tools in this study: Text was added to address this in the Modeling Protocol.

EPA Region 8 Comments

EPA Region 8 commented that the approach was generally consistent with the Denver EAC SIP modeling approach, with the exception of using the new CONCEPT emissions model for on-road mobile source emissions in the Denver area. EPA/OAQPS responded that LADCO is using the CONCEPT emissions model and since it uses the EPA MOBILE6 emissions factors for mobile source emissions there should not be a problem in its use.

Comments from Noble and COGA

Noble and COGA submitted several general and specific comments on the preliminary draft Modeling Protocol.

1. General Comments

A. Schedule and Resources to Perform the Work: Noble/COGA raise concerns that the study is subject to a very tight time schedule, is under funded and is not part of the normal SIP process where areas are designated nonattainment and there are several years to prepare a SIP. Rather than the previous EAC and the current work efforts that have much tighter schedules.

- Response: The ENVIRON/Alpine Team is also concerned with the tight schedule and with more funding could perform a more comprehensive study. However, these are the realities of the situation that Denver has found itself in and we believe we have designed a plan to develop an accurate and reliable ozone control plan in a timely fashion. Of course additional resources and/or time would enhance the study.

B. Accounting for Recently Implemented and Required Future Emission Reductions in the 2010 Base Case: Noble/COGA want assurances that control measures being put in place will be accounted for in the 2010 base case. They would also like to quantify the reduction in biogenic emissions related to the bark beetle infestation of the conifer forests.

- Response: The modeling team will work with the RAQC/CDPHE to make sure all on-the-books control measures are accounted for in the 2010 base case. For the oil and gas emissions, we plan on using 2010 and 2020 emissions for the D-J Basin from the WRAP Phase III work effort funded by IPAMS, which will be based on data obtained from the operators including Nobel and members of COGA. So these data should accurately reflect the controls on oil and gas emissions if the operators provide such data. We are looking into using land cover data that NCAR has generated for 2000, 2010, 2020 and 2030 that accounts for changes in land cover (e.g., urban sprawl). However, it does not include information on the bark beetle kill zones and our current scope of work does not include using these data. Although it would be an interesting research project to incorporate the kill zones into the analysis, the kill zones by 2010 are small compared to the overall coverage of the conifer forest and ozone formation in these rural forested

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areas will likely be more NO_x-limited so we do not expect the bark beetle infestation to have a significant effect on ozone formation by 2010.

C. Meteorological Effects on Ozone Concentrations: Noble/COGA note three aspects on how meteorological conditions affect ozone in the Denver area and ask how they will be reflected in the modeling: (1) strength of high pressure measured as height of 500 mb level; (2) potential for storage of elevated ozone aloft overnight that is mixed down during the day; and (3) use of HYSPLIT trajectory analysis.

- Response: The evaluation of the MM5 will look at comparisons with the observed 500 mb heights, which is something the MM5 typically replicates fairly well. The storage of a reservoir of ozone aloft at night that is mixed down during the day will be difficult to evaluate in the model. For some days we do have ozonesonde vertical soundings of ozone measurements at Boulder that can be used to compare against the modeled vertical ozone profile. We may also look at where the Denver ozone plume goes at night either using a 3-D visualization tool (e.g., Vis5D or IDV) or EPA has a new visualization tool to replace PAVE that can more easily generate vertical slice plots (VERDE). The modeling team has no plans to use the HYSPLIT trajectory model.

D. Photochemical Reactivity and the Relationship Between NO_x and VOC Emissions:

Noble/COGA raise concerns about the VOC speciation used in the photochemical modeling and due to limited speciation measurements source are assigned “similar” VOC speciation profiles. They also want a better study of the relationship of VOC and NO_x emissions and reiterate the need to account for controls on oil and gas production emissions between 2006 and 2010.

- Response: For EPA, ENVIRON has just updated the CB05 VOC speciation profiles used in the SMOKE emissions model using the SPECIATE4 database. For the December 2007 Fast Track emissions modeling generated by December 2007 we are using the default CB05 speciation and source cross reference files. If Noble/COGA has better VOC speciation profiles for their sources they could be used in the revised emissions modeling in February 2008. The changes in VOC and NO_x emissions from oil and gas sources between 2006 and 2010 will be based on survey results from the operators prepared as part of the WRAP Phase III activities funded by IPAMS.

II. Specific Comments

A. Section 1.4 – Related Regional Modeling Studies: Noble/COGA support the use of 4 km grid spacing and to not pursue the 1.33 km grid spacing as was done in the EAC modeling. However, they raise concerns about use of the 2006 modeling period since, outside of ROMANS that also used 2006, there will be a loss of comparability with WRAP and FCAQTF studies that used the 2002 and 2005 years, respectively.

- Response: The use of the 1.33 km grid in the EAC was a significant time and resource sink in the EAC modeling and because of the poorer model performance, the final EAC SIP modeling used the 4 km modeling results, so given the limited time and resources we believe it was best to pursue just using the 4 km grid and are pleased that Noble/COGA concur. Section 3.2 of the Modeling Protocol describes the rationale for the episode selection with a key factor being having sufficient high ozone days to apply the EPA 8-hour ozone projection approach to project the observed 2005-2007 8-hour ozone Design Values to 2010. The 2002 period is too old and not appropriate for projecting 2005-2007 Design Values and the 2005 period has fewer high ozone days than 2006.

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B. Section 1.5.1 – Ozone Episode Selection: Noble/COGA agrees with the selection of the June-July 2006 modeling period.

- Response: Agree.

C. Section 1.5.2 – Model Selection: Noble/COGA agrees with model selection and reiterates the need to account for land cover change effects on biogenic emissions to account for bark beetle and changes in agricultural and urban land use.

- Response: We have had discussions with the developers of MEGAN at NCAR on how to account for changes in land cover on the biogenic emissions and they thought it would be an interesting research project. At this time our plan is to hold the land cover data constant from 2006 to 2010, but we will revisit this issue with RAQC and continue our dialogue with NCAR over how these effects could be accounted for. Unfortunately the Denver 8-hour ozone SIP modeling can not afford to be bogged down by a research project. However, if NCAE proceeds with an analysis of changes in land cover effects on biogenic emissions using MEGAN we will revisit this issue in the future. But the current plans remains to hold biogenic VOC and NOx emissions constant between 2006 and 2010 and 2020. Note that if the bark beetle infestation does result in significant reductions in biogenic emissions then the 2010 modeling will be conservative (i.e., would not jeopardize the demonstration of attainment).

D. Section 1.5.5 – QA/QC and Diagnostics: Noble/COGA supports the model performance evaluation and diagnostic/sensitivity studies.

- Response: Agree.

E. Section 1.5.7.1 – Traditional Sensitivity Testing: Noble/COGA support the use of diagnostic sensitivity tests to look at biogenic emissions as well as the effects of congestion on on-road mobile sources. They also support the use of ozone source apportionment, although are sensitive to the oil and gas sector being “singled out”.

- Response: The effect of changes in land cover on biogenic emissions has been discussed previously and evaluating their effects in a sensitivity test is a good idea. If DRCOG can provide the effects of congestion on on-road mobile sources in the 2010 link-level VMT data we can model their effects on emissions using CONCEPT. We do not believe that the sensitivity and ozone source apportionment singles out the oil and gas sector as it is just one of the five major source categories that we will obtain ozone impacts for.

F. Section 1.5.7.2 – Diagnostic Tests: Noble/COGA raise concerns about why probing tools will not be used to help improve the model performance for the 2006 base case given the performance issues for the 2002 base case in the EAC SIP. Noble/COGA endorses the use of additional diagnostic methods, such as pollutant speciation and use of indicator species and species ratios to improve model performance but the work described is sketchy in the Modeling Protocol and more clarification is requested.

- Response: The use of the Probing Tools is quite resource, time and labor intensive. The Probing Tools can provide more information about a given modeling database, but are not a substitute for diagnostic sensitivity modeling using alternative inputs to identify a

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better performing database. Given the limited time and resource constraints of the study, we could only allocate approximately 2 months to the diagnostic testing and much of that would focus on alternative inputs (e.g., meteorological realizations, biogenic emissions, other emissions, level of mixing) that could improve model performance. We agree with Noble/COGA that the use of Probing Tools could be beneficial, but believe the focused diagnostic tests are more beneficial. We would welcome Noble/COGA to fund additional diagnostic tests including Probing Tools. Regarding the use of speciation, indicators ratios, etc. in the model evaluation we are still evaluating what data are available so cannot be too specific at this time. We have received the 2006 VOC speciation measurements from CDPHE and are excited that we will have this important piece of data in the evaluation. We have also received the Boulder ozonesonde data and, although limited during our modeling period, they could also be very valuable.

G. Section 1.5.7.8 – Weight of Evidence: Noble/COGA note reference to WOE analysis by stakeholders and would be interested in collaborating.

- Response: We have no issues with collaboration on the WOE analysis.

H. Section 1.5.10 – Future Year Control Strategy Modeling: Noble/COGA stress that the selection of control measures should be a transparent process and should accurately reflect source contributions to the ozone problem.

- Response: RAQC and CDPHE will be defining the control measures that the modeling team will be running. They have set up a series of meetings to address this issue.

I. Section 1.8 – Schedule: Noble/COGA again raise concerns about the compressed schedule relative to the more typical SIP process, but endorse the 2 month period of diagnostic testing.

- Response: The Modeling Team is also concerned about the compressed schedule.

III. Final Thought

Greenhouse Gas (GHG) Emissions: Noble/COGA raises the issue that GHG should be considered in the ozone control measure evaluation.

- Response: The Modeling Plan does raise the issue that the effects of the ozone control measures on PM, visibility and deposition should be considered as well as their effects on ozone. Thus, the consideration of the effects of the ozone control measures on GHG emissions is a consistent theme.

Comments from ERAS, Inc.

1. Ethanol Market Share Sensitivity Tests: ERAS, Inc. suggests running a 100% and 0% E10 market share sensitivity test to bound the effects of ethanol market penetration and if lower RVP is being considered sensitivity tests with a 7.0 psi RVP gasoline with and without the ethanol waiver.

- Response: Current plans for the 2010 sensitivity modeling is to perform targeted source category VOC and NOx emissions reductions sensitivity tests starting with a 2010 base case that would assume a specific E10 market penetration to be determined. ERAS is suggesting several additional sensitivity tests designed to look at specific issues associated with ethanol (E10) penetration that are currently outside the scope of work of the RAQC contract with the modeling team. RAQC does have two 2010 sensitivity tests

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to be defined, but they would like to keep them open to address issues that will likely come up. I'm sure RAQC/CDPHE would welcome resources to perform additional sensitivity tests beyond what is defined in the current scope of work and budget.

2. CO Sensitivity Tests: ERAS suggests that a CO emission reduction sensitivity test be conducted, at least for mobile source emissions.

- Response: The modeling team has added an additional sensitivity test to reduce on-road mobile source CO emissions by 20% increasing the number of 2010 emission reduction sensitivity tests from 10 to 11, plus 2 to be determined.

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