STATE OF COLORADO

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Colorado Department of Public Health and Environment

April 27, 2011

Roxanna Witter, MD, MSPH, MS
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Aurora, CO 80045

Dear Dr. Witter:

The Colorado Department of Public Health and Environment (the department), is pleased to offer its comments on the revised "Battlement Mesa Health Impact Assessment," (HIA). The comments that follow are based on reviewing this revised draft HIA to determine whether the comments the department previously offered were incorporated into this revision and to offer additional comments to enhance the HIA report. The department appreciates the opportunity to participate in this HIA process and looks forward to providing continued assistance to the Garfield County Public Health Department and the citizens of Garfield County.

General Observations
As stated in earlier comments, the department continues to question whether an HIA, with broad conclusions and recommendations, represents an appropriate tool for assessing the health impacts involving a single permit applicant; or whether it would be better utilized for the evaluation of potential changes to air quality, water quality and waste disposal regulations designed to protect public health and environment. Therefore, the department recommends that careful consideration of the use of this tool be utilized to provide a balanced approach of assessing oil and gas operations in the Battlement Mesa area. The following comments have been provided by technical experts from several department divisions to further enhance and improve the accuracy to the HIA.

Air Pollution Control Division Oil and Gas Team responsible for permitting and enforcement of State of Colorado air quality control regulations provided the following comments.

- Executive Summary - Section II, Page ES-page III, 1st paragraph: The last sentence states "Attention to preventing minor spills and accidents, tracking and analysis of near-misses, and the analysis of incidents when they do occur will provide the information necessary to prevent a catastrophic event." Because these efforts would not necessarily prevent a catastrophic event, a text revision is recommended. For example, "Attention to preventing … will provide *information that can be used to help prevent* a catastrophic event."
- Section 5.1.3, page 34 - 2nd paragraph: The report indicates that combustors will be used to control VOC emissions from tanks to comply with Colorado Oil and Gas Conservation Commission (COGCC) rules. Actually, the COGCC rule only requires that tanks emitting at least 5 tons per year (tpy) VOC be controlled if they are located within ¼ mile of affected buildings. Therefore, it is possible that the

COGCC control rule would not apply to one or more tanks in the Antero project. Note that Air Quality Control Commission (AQCC) Regulation No. 7, Section XVII.C.1 requires controls for condensate tanks that emit at least 20 tpy VOC.

- Section 5.1.3, page 34 - 2nd paragraph: The report states "Applying a 95 percent control efficiency to the potential VOC emissions estimated for the Watson Ranch pad (Appendix E, Antero comment A34) results in 3.4 to 20 tons per year of VOC emissions from the production tanks on all 9 proposed well pads combined." It is not clear how this range of emissions was calculated. Antero comment A34 is a reference to their Exhibit 2, which is titled "COGCC Response to Gasland." The previous draft HIA reported that there would be 37 tons of VOCs per pad (That estimate included methane; methane emissions appear to not be counted in this 2nd draft, as requested by the Division.) If there is a reference available that provides data behind the emission calculation, it would be helpful to include it in this HIA.
- Section 5.1.3, page 34 - 2nd paragraph: The report states "Therefore, vapor recovery is preferred over venting or combustion for controlling fugitive VOC emissions." Vapor recovery units and combustors (flares) do not control fugitive VOC emissions; the term "fugitive" should be removed from this sentence.
- Section 5.1.3, page 34 -3rd paragraph: The report states "We know that well completion operations emit the higher levels of contaminants than drilling operations. The 2008 Garfield County Air Toxics Study….concluded that the well completion activities emit larger volumes of VOCs than drilling activities." The meaning of terms "higher levels" and "larger volumes" are not clear. Did the study show that emission rates were higher during well completions vs. drilling operations or were total emissions (generally reported in units of mass, e.g., tons per day) higher? Emissions are not generally reported in units of volume. It is recommended that the text be revised accordingly.
- Section 5.1.3, page 36 - 2nd paragraph: The report states "We know that fugitive emissions from pipes, valves, pneumatic devices, wellheads, and from maintenance operations have the potential to impact….." Fugitive emissions are defined as "those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening." Emissions from pneumatic devices and maintenance operations are not considered to be fugitive. Fugitive emissions from wellheads would be from components, such as valves. Pipes themselves are not generally described as being sources of fugitive emissions; it is the components that connect them that leak (e.g., flanges). In Garfield County, if VOC emissions from a facility are greater than 5 tpy (including emissions from the condensate tank) and if fugitive emissions are greater than 2 tpy, the facility must report the fugitive VOC emissions and the emissions must be permitted. All emission sources that have greater than 2 tpy VOC must report those emissions to the Division. It is suggested that the text be revised accordingly, or deleted.
- Section 5.1.3, page 36 - 2nd paragraph: The report states "COGCC rules require that no bleed valves be used on pneumatic devices, where technically feasible..." Actually, the COGCC rule also allows that low bleed valves may be used. Essentially, the rule does not allow high bleed valves to be used. The text should be revised accordingly.
- Section 5.1.4, page 38 - 2nd paragraph: The second bullet states "There is a significant greater potential for exposure to chemicals in air during well completions activities than during production activities." The term "significantly" is not explained with data. It is a very strong term; it is suggested that it either be removed or a reference added that supports that statement or further information be provided to explain better what is meant by "significantly." Also, it is not clear what type of exposure is being referred to. Does this refer to short-term acute exposure from higher emission rates during completions

vs. production? The well completion activities take place over a much shorter time period than the production activities.

- Section 5.1.5, page 39 - last bullet: This bullet refers to "routine maintenance." It is not clear if it is referring to routine maintenance of low-bleed valves or to routine maintenance in general (EPA Natural Gas STAR provides information on maintenance of various emission sources). It is suggested that this language be revised/clarified. Also, the term "Star" should be in all caps, "STAR."
- Section 5.1.5, page 39 - last paragraph: The report states "Compressor stations are sources of fugitive emissions and noise." That is certainly true. However, emissions from compressor stations are much higher than fugitive emissions from the stations (e.g., non-fugitive emissions from the engines). It is recommended that the word "fugitive" be deleted from this sentence.
- Section 5.2, page 40 -1st paragraph: This table indicates that the magnitude of health effects is "low to high", which the Division agrees with. The table in Section 4.1, page 29, was not revised and still indicates a magnitude of "moderate to high". The table in Section 4.1 should be revised to match the table in Section 5.2.

The Air Pollution Control Division (APCD) Technical Services Program engaged in Monitoring and Modeling of air quality for the State of Colorado provided the following comments.

- ES-page III, last sentence - Specific values should be listed for the "current setback distances from a well pad…" Is it the same as the "near a well pad" distance of ½ mile listed on ES-page II?
- Section 2 .1, p. 10 - Under 3), "We need to determine safe setbacks." This statement may be confusing to many of the general public. Should define that this is a distance from a source. (See also in Section 2.2 under 3) on p. 11.)
- Section 3.1, p.13 - Under 11, "…collection of 24-ambient air samples and grab samples…" should probably read "…collection of 24-hour VOC ambient air samples and VOC grab samples…"
- Section 5.1.1, p. 31 - In the first paragraph of this section, it includes PM2.5 as a contaminant that is a human carcinogen. As you mention in responses to comments, EPA risk assessment documents do indicate lung cancer associated with long term PM2.5 exposure. It should be noted, however, that in all readily available EPA documents that are designed for general public information (e.g. on AIRNow), cancer is not mentioned as a health impact from PM exposure. Rather, it is possible that constituents of some the particles may be carcinogenic.
- Section 5.1.2, p. 32 - The first sentence of the second paragraph states, "…Battlement Mesa does not contain any industrial activity." That may be true, but there are commercial gasoline stations/convenience stores that have vent pipes that do emit VOC's. These are not mentioned in the text.
- Section 5.1.2, p. 32 - The third paragraph discusses ozone and that it is "…likely to increase as nitrogen oxide increases." "May possibly increase," would be a better term as ozone formation is complex and is not necessarily a linear relationship. It is quite possible that ozone levels will decrease (not increase) in the near area with increased nitrogen oxides due to the chemistry.
- Section 5.1.2, p. 32 - The third paragraph is very confusing as to where ozone monitoring is occurring, and for how long. CDPHE ozone monitoring in Rifle only commenced in 2008. EnCana monitoring is of reasonable quality since 2007. USFS ozone monitoring may have commenced back in 2005 (APCD only has data back to 2006), but not using reference/equivalent analyzers and only in the summer. It is uncertain how trends are being determined with limited data from varying locations.
- Section 5.1.2, p. 33 - In the first paragraph, it states that PM10 exceeded 150 ug/m3, "…likely due to natural gas construction activities." Unless back trajectory analyses were performed, it may be premature to say that it is "likely." If it was due to natural gas construction activities, one would expect that additional high values would have been seen in the data rather than one single very high day at 210 ug/m3. The next highest value for the year was 136 ug/m3. The overall trend at the Parachute site has been upward, which may be indicative of increasing natural gas operations, but associating one high day

with no supporting information is questionable. APCD strongly suspects that this high value was actually due to building construction activities where the sampler is located, but did not have enough supporting evidence for an exceptional event designation.

- Section 5.1.3, p. 36 - In the third paragraph, the same comment as above for Section 5.1.2.
- Section 5.1.3, p. 37 - In the third paragraph, it mentions radon as a pollutant that has,"…not been measured in Garfield County relative to the natural gas industry." Radon may be a health concern, but it is naturally occurring in the ground and would not be related to the natural gas industry.

The Department's Disease Control and Environmental Epidemiology Division Toxicologist provided the following comments.

1. Table 4-1-Toxicity Values – Overall, it would be a good idea to QA/QC all acute, subchronic, and chronic toxicity values and the corresponding risk tables. Some chemicals for which toxicity values need to be revised are noted below. In addition, it would be useful to include the most sensitive critical endpoint used for the derivation of a toxicity value.

   - *1,2,3-Trimethylbenzene*

     Chronic RfC = 5.00E-03 mg/m^3 based on PPRTV (vs. 7.00E-03 mg/m^3)
     Subchronic RfC = 5.00 E-02 mg/m^3 based on PPRTV (vs. 7.00E-02 mg/m^3)

   - *1,3,5-Trimethylbenzene*

     Subchronic RfC = 1.00 E-02 mg/m3 based on PPRTV (vs. 6.00E-02 mg/m^3)

   - *Ethylbenzene*

     Subchronic RfC = 9.00 E+00 mg/m^3 based on PPRTV (vs. 1.00E+00 mg/m^3)

   - *Toluene*

     Subchronic RfC = 5.00 E+00 mg/m^3 based on PPRTV (vs. 9.23E-01 mg/m^3)

2. Section 7.2 (p. 64 to 66) – Conclusions - General conclusions stated in this section need to be revised to reflect the comments noted below (# a to b). Overall, the department feels that the quantitative findings of the health risk assessment do not support a potential for developmental effects such as birth defects. In addition, the identified list of risk driving chemicals for ambient air and surface water needs to be modified. In particular, it is important to revise the following statement (p. 65).

   > "Noncancer health effects may include respiratory effects such as upper air way irritation, and decreased lung function; neurological effects may include respiratory effects such as upper way irritation and decreased lung function, neurological effects such as headaches and dizziness, immunological effects such as anemia, and developmental effects such as birth effects."

   (a) First bullet (p. 65) – Acute Child Noncancer Hazard – Please note the following comments:

   - It is stated that contributors to the child acute HI include benzene, trimethylbenzenes, and n-nonane in ambient air and toluene in surface water. Please note that trimethylbenzenes and n-nonane are not even identified as acute contaminants of potential concern (COPCs) in Table 5-6. Also, the results in Table 5-6 demonstrate that the primary contributor to acute ambient air risks is benzene (HQ ranging from 2.1 to 6.2). It is important to emphasize that these conclusions are based on an extremely conservative assumption because of the use of a 15-second grab sample data to evaluate

acute risks for exposure period of up to 14 days. This type of finding can better be used to support the need for additional short-term monitoring to appropriately estimate acute hazards. For example, the department found that none of the 27 grab sampling sites had a HQ for benzene exceeding a value of one for the 6-hr exposure duration based on the California EPA's acute toxicity value of 1300 µg/m³ (the department, 2007; Screening level health risk assessment).

- It is shown in Table 5-6 that the cumulative hazard (HI) for surface water is 15.0. The primary contributor to this HI is benzene with an HQ of 10.0 which was calculated using the subchronic oral RfD. It is important to isolate this HQ from the estimation of cumulative risks because the HQ for benzene in surface water is estimated using the subchronic toxicity value based on the liver toxicity as the most sensitive critical endpoint and the HQs for toluene is calculated using the acute toxicity value based on the neurotoxicity as the most sensitive critical endpoint. In addition, a foot note to the table should explain the assumption of using the subchronic toxicity value for benzene in the absence of an acute toxicity value (RfD).

- The most sensitive critical endpoint/target organ for acute COPCs in ambient air as well as surface water does not include developmental effects. For toluene, the most sensitive critical endpoint via inhalation and oral exposure pathways is neurotoxicity. Please note that the toxicity values for toluene are not derived based on the developmental effects because these are not the most sensitive endpoint. Toluene has been shown to cause congenital defects in infants born to mothers who abused toluene during pregnancy. Exposure levels in the available studies, if reported at all, were very high (EPA IRIS). For benzene, the target organ is the immune system (decreased lymphocyte count) via inhalation and the target organ is the liver via oral pathway. Therefore, the stated conclusions should be revised by eliminating the potential for developmental effects such as birth defects. If the potential for certain types of health effects is included based on the qualitative findings, it should be specified. If these findings are included based on the literature review, it is important to include a brief discussion of the findings/studies in appropriate sections of the risk assessment.

(b) Second bullet (p. 65) – Acute Adult Noncancer Hazard - It is stated that contributors to the adult acute HI include benzene, trimethylbenzenes, and n-nonane in ambient air. The results in Table 5-7 demonstrate that the primary contributor to acute ambient air HI of 2.1 to 7.0 is benzene (HQ ranging from 2.1 to 6.2). Furthermore, trimethylbenzenes and n-nonane are not even identified as acute COPCs in Table 5-7.

(c) Third Bullet (p 65) – Subchronic Noncancer Hazard – It is stated that the xylenes, trimethylbenzenes, toluene, and benzene are the primary contributors to the estimated HI of 2 to 8 for the subchronic noncancer hazard to child, adult, and elderly residents living near a well pad. It should be noted that toluene cannot be considered the primary contributor to this HI based on the data shown in Table 5-5 (HQ = 0.12 to 0.48) of the report and the revised HQs shown in the department's Table1 (i.e., HQ = 0.02 to 0.06). Furthermore, it is important to discuss the primary contributors to the HI based on the segregation of the most sensitive critical endpoint/target organ used for the derivation of the toxicity value. The revised subchronic hazard estimation by the department (Table 1), using the same inhalation intake as provided in Table 5-5 of the HIA, indicates that the subchronic HI ranges from 2.7 to 13.4 (vs. 2 to 8 per Table 5-5) and the primary contributors to this HI based on the most sensitive critical endpoint/target organ are as follows:

- *Neurological HI of 2.3 to 11.1* = 1,3,5-trimethylbenzene (HQ = 2 to 7.8); m-p-xylene (HQ = 0.06 to 2.2); o-xylene (HQ= 0.5)
- *Hematological (decreased blood clotting time)HQ* =1,2,4-trimethylbenzene (HQ = 0.03 to 1.2)
- *Immunological (decreased lymphocyte count) HQ* = benzene (HQ= 0.25 to 0.85)

Please check this discrepancy between the department's Table 1 and HIA Table 5-5. In addition, it is not necessary to use the chronic toxicity value for a handful of chemicals in the absence of subchronic toxicity values because these chemicals are not adding much value to the estimation of noncancer hazards but are adding the unnecessary uncertainty. As shown in the department's Table 1, subchronic toxicity values are available for the primary contributors to subchronic hazards.

(d) Fifth bullet (p.66) – Chronic Noncancer Hazard – It is important to revise the discussion and Table 5-4 for chronic HI ranging from 1 to 3 as per our comments provided above for the subchronic HI.

Chemical	**RfC (µg/m³) (Source)**	**Target organ/critical endpoint**	**Max. intake (µg/m³)**	**Max. HQ (µg/m³)**	**95UCL intake (µg/m³)**	**95 UCL HQ (µg/m³)**
1,2,3-Trimethylbenzene	50.0 PPRTV	Neurological	11.7	0.23	3.2	0.064
1,3,5-Trimethylbenzene	10.0 PPRTV	Neurological	77.5	**7.75**	19.5	**1.95**
Toluene	5000.0 PPRTV	Neurological	319.0	0.06	92.1	0.02
m-, p- Xylene	400.0 PPRTV	Neurological	884.0	**2.2**	244.0	0.061
o-Xylene	400.0 PPRTV	Neurological	190.0	0.48	48.5	0.12
n-Hexane	2000.0 PPRTV	Neurological	255.0	0.13	79.6	0.04
n-Nonane	2000.0 PPRTV	Neurological	303.0	0.15	75.5	0.038
n-Pentane	10,000.0 PPRTV	Neurological	553.0	0.06	213.0	0.02
Cumulative HI (Neurological)				**11.06**		**2.31**
1,2,4-Trimethylbenzene	70.0 PPRTV	Blood clotting time decrease	83.0	**1.19**	2.11	0.03
1,4-Dichlorobenzene	2500 HEAST	Increased liver wt. in P1 males	2.3	0.0009	2.3	0.0009
Benzene	80.0 PPRTV	Decreased lymphocyte count	68.5	0.85	20.04	0.25
Ethylbenzene	9000.0 PPRTV	Ototoxicity	228.0	0.025	50.36	0.006
Methylcyclohexane	3000.0 HEAST	Kidney	723.0	0.24	194.0	0.06
Methylene Chloride	3000.0 HEAST	Liver	2.9	0.0009	2.9	0.0009
Cumulative HI (All endpoints)				**13.37**		**2.66**
	Chronic RfC (µg/m³)	**Target organ**	**Max. intake (µg/m³)**	**Max. HQ (µg/m³)**	**95UCL intake (µg/m³)**	**95 UCL HQ (µg/m³)**
1,3-Butadiene*	2.0	Reproductive	0.166	0.083		0.083
2-Hexanone*	30.0	Neurological	4.4	0.147		0.147
Acetaldehyde*	9.0	Nasal/Respiratory	1.96	0.218		0.218
Formaldehyde*	9.8	Nasal/Respiratory	10.02	**1.04**		**1.04**

Table 1. Subchronic Noncancer Hazard Estimates near a Well Pad
*Chemicals for which subchronic toxicity values are not available

Thank you for the opportunity to comment on the 2nd draft of the Battlement Mesa HIA. The department looks forward to reviewing the final HIA document. Please contact me if you have any questions concerning these comments or if you would like to arrange a meeting with the department's review team that prepared these comments.

Sincerely,

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cc: Dave Neslin, Director Colorado Oil and Gas Conservation Commission
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