VRANESH AND RAISCH, LLP
ATTORNEYS AT LAW
5303 Spine Road, Suite 202 Boulder, Colorado 80301
Telephone: 303.443.6151 www.vrlaw.com

TO:	Blake Beyea, Water Quality Control Division
FROM:	Climax Molybdenum Company
DATE:	July 1, 2021
RE:	Update on Climax Molybdenum Company's Temporary Modification Blue River Segment 14 (Upper Colorado River Basin, Regulation 33)

1. Introduction.

The purpose of this memorandum is to update the Water Quality Control Division (Division) and molybdenum standard stakeholders concerning the Climax Molybdenum Company (Climax) work to resolve uncertainty associated with the 210 µg/L molybdenum (Mo) water supply standard applicable in Tenmile Creek, Blue River Segment 14 (COUCBL14).

In summary, we are pleased to report that:

- Climax continues to maintain current conditions;
- Independent review of molybdenum science continues to advance; and
- Climax continues to evaluate potential options for molybdenum source management and treatment.

2. Background.

The Climax mine facility discharge is the beginning of Tenmile Creek, Blue River Segment 13 (COUCBL13). Segment 13 flows down into Segment 14 (COUCBL14) where it is joined by West Tenmile Creek. Segment 14 then flows into Dillon Reservoir. Segment 13 is not classified as water supply and therefore the molybdenum standard does not apply in Segment 13.

Segment 14 is classified as water supply. The Water Quality Control Commission (Commission) adopted the 210 µg/L molybdenum standard in Segment 14 at the 2014 Colorado River Basin hearing. The Commission also adopted a "current conditions" temporary modification in 2014 to allow more time for additional information to be developed concerning the standard necessary to protect human health. *See* Regulation 33, § 33.52(J). The temporary modification was supported by a 2014 Plan.

A rulemaking hearing to consider revision of the human-health water supply standard for molybdenum (as well as the agriculture standard) was scheduled for December 2017. Ultimately, the Commission continued that rulemaking, and instead extended the molybdenum temporary modification in a January 2018 hearing. *See* Reg. 33, § 33.60. Climax supported extension of the temporary modification with its 2017 Plan to Resolve Uncertainty.

At the December 2019 Temporary Modifications hearing, the Commission extended this temporary modification to June 30, 2023. *See* Reg. 33, § 33.63(A). Climax supported extension of the temporary modification with an Addendum to its 2017 Plan.

Climax provided written updates to the Division and interested stakeholders in June 2019 and July 2020, provided a briefing to stakeholders on molybdenum science in September 2019, and continues to provide updates to and engage with stakeholders at a variety of forums. An update was also provided to the Commission as part of the 2018 and 2019 Temporary Modifications hearings.

3. Impact of the COVID-19 Pandemic on Climax Operations and Future Production Needs

In 2020, Climax took many actions to revise its operating plans driven by the significant volatility in the market and world economies as a result of the COVID-19 pandemic. Molybdenum production, considered an essential business, was reduced by approximately 50% from April 2020 through the end of the year by taking the Climax milling operation to a 14 day/month operating schedule. A workforce reduction was also required.

Markets in 2021 have strengthened; demand and commodity prices have risen correspondingly. Operational plans are built based on these factors and fluctuate as economic factors fluctuate. Current business plans require a 16 million pound/year production rate from Climax for the next several years. Climax has the capacity to produce at a 30 million pound/year rate and could at any time be needed to produce at these levels. Resolving the uncertainty and developing a scientifically-sound molybdenum water supply standard is critical to Climax to deliver on business objectives.

4. Update on Plan to Resolve Uncertainty for Molybdenum Water Supply Standard.

a. ATSDR Toxicological Profile for Molybdenum.

As we noted in our July 2020 Update, the Agency for Toxic Substances and Disease Registry (ATSDR) released its Toxicological Profile for Molybdenum in May 2020. It

included a Minimum Risk Level (MRL) of 0.06 mg Mo/kg/d which was based on a no observed adverse effect level (NOAEL) of 17 mg/kg/d, an interspecies uncertainty factor of 10, an intraspecies uncertainty factor of 10, and a modifying factor of 3.

In a letter to ATSDR dated March 24, 2021, the International Molybdenum Association (IMOA) agreed with ATSDR's determination of the NOAEL which was based on a study by Murray et al. (2014), which ATSDR deemed a "high quality" study. IMOA strongly disagreed with ATSDR's determination to apply a total uncertainty factor of 100 (10x10) plus a modifying factor of 3. ***See* Appendix A**.

In applying the modifying factor of 3, ATSDR speculated that a modifying factor should be applied because of the results of the Fungwe et al. (1990) study (which it acknowledged was of lesser quality) suggested that the NOAEL in copper deficient populations may be lower than the NOAEL determined by Murray. IMOA supported its objection to ATSDR's application of the modifying factor with a detailed review of the Fungwe study, identifying 19 deficiencies and limitations of the Fungwe study. The review concluded that because of its many flaws, the Fungwe study should not have been used by ATSDR as a basis to speculate that deficient copper levels in the diet used by Fungwe might explain the difference in results between the Fungwe and Murray studies. Therefore, there is no support for application of a modifying factor of 3. *See* **Appendix A** (*starting on PDF page 6*).

IMOA also noted that ATSDR's application of uncertainty factors and a modifying factor was inconsistent with practices used by other regulatory and scientific organizations for molybdenum and other trace elements. IMOA submitted a review of 21 risk assessments of trace elements conducted by other agencies that showed ATSDR's applications of an intraspecies uncertainty factor of 10 was the only instance where a factor of 10 was applied. *See* **Appendix A** (*starting on PDF page 18)*. In conclusion, IMOA requested that ATSDR reconsider its application of the intraspecies uncertainty factor of 10 and modifying factor of 3.

Climax supports the concerns raised by IMOA in its letter to ATSDR. To date, ATSDR has not replied. Given the unfortunate and unconventional outcome of this aspect of the ATSDR review, Climax is considering how it may address the modifying factor including but not limited to the potential for a narrow, focused study that addresses this speculative ATSDR discussion of Fungwe.

b. Produce Study

One of the factors in the equation for calculating a human-health based water quality standard for molybdenum is the relative source contribution (RSC), which accounts for molybdenum exposure in the drinking water versus diet. *See* WQCC Policy 96-2. The

default RSC value is 0.2, which means a person can have 20% of their exposure in drinking water, and 80% in diet.

In the case of molybdenum, data indicate that dietary exposure is generally low. In an October 2020 meeting, the Division questioned whether dietary exposure to molybdenum could be higher in Summit County near where the Climax Mine is located, positing that higher levels of natural molybdenum in the soils could contribute to higher levels of molybdenum in locally grown produce. The Division suggested that an exception to the default RSC of 0.2 (e.g., the RSC of 0.8 recommended by EPA in 2017)[1] could be made if there was data showing consumption of locally grown produce (which could have a higher molybdenum content) is not an issue.

Climax conducted a review of locally grown produce to provide additional information as to the correct RSC to use in calculating a human health standard for molybdenum. Based on this review (attached as **Appendix B**), it can be concluded that:

- There is little local produce being grown in Summit County due to the climate;
- Produce that is being locally grown is grown with non-native soils, i.e., soils that would have average molybdenum concentrations; and
- Produce that is being locally grown is being grown with water that has molybdenum concentrations below the current water quality standard of 210 μg/L.

Therefore, there is no evidence to suggest that residents in Summit County are exposed to more molybdenum in their diet than an average person in Colorado, or nationally. It can be assumed that molybdenum in diet is low in Summit County, and an RSC of 0.8 (80% of molybdenum exposure from drinking water, 20% from diet) as proposed by EPA in 2017 would be protective.

c. Monitoring Update

i. Effluent and Stream Data

Climax has continued to monitor at multiple locations including the following:

- Outfall 001A
- Blue River Segment 13 above confluence with Tenmile Creek

[1] EPA's Responsive Comments on the Proposed Revisions to Regulation 31 and 33, p. 7 (Oct. 27, 2017).

- Blue River Segment 14 below confluence with Tenmile Creek
- Blue River Segment 14 at Frisco
- Blue River Segment 17 below Dillon Reservoir

Data is available to the public on the Climax website, https://climaxmoinco.com, under the "Water Standards Resources" tab. Graphs of the molybdenum data to date are included in **Appendix C**.

ii. "Current Conditions" Update

In the Statement of Basis and Purpose from the December 2019 Temporary Modifications hearing, the Commission established baseline criteria for Tenmile Creek utilizing data from May 2012 to June 2014. Using the ambient standards assessment methodology, the lower confidence limit (LCL) for the 50th percentile for the instream molybdenum concentration was established to be 170 µg/L for baseline. Climax evaluated data from July 2014 to June 2021 at the 3rd Ave Bridge in Frisco, Colorado, and determined the LCL for the 50th percentile for that data set to be 151 µg/L using the N value of 106, as outlined in Division's 303(d) Listing Methodology.

In the same hearing, the Commission also established the baseline LCL for the 50th and 95th percentile for effluent molybdenum concentrations of 490 µg/L and 1,610 µg/L, respectively. Climax evaluated data from July 2014 to June 2021 at Outfall 001A and determined the LCL for the 50th percentile to be 374 µg/L, and the LCL for the 95th percentile to be 1,293 µg/L, using an N value of 84.

Based on the recently calculated LCL, which is below the baseline LCL for the instream and effluent concentrations of molybdenum, Climax has preserved status quo and is within current conditions as established in the December 2019 Temporary Modification Hearing.

d. Status of Treatment Alternatives

Climax's 2020 Update included a detailed summary of the investigation of treatment alternatives.

Since that update, Climax has been working with the Colorado School of Mines to examine an additional treatment alternative. A project update is included in **Appendix D**.

Climax wishes to point out that preparation of cost information based on a 210 µg/L standard should not be interpreted to mean that Climax is suggesting that a 210 µg/L standard is appropriate. To the contrary, based on information presented by Climax at

the 2017 hearing concerning the molybdenum standard, Climax continues to believe that the appropriate standard to protect water supply should be considerably higher.

Climax also notes that there are additional alternatives that may be economically and/or technically feasible, but because of the difficulty associated with planning and designing a treatment facility without knowing the ultimate molybdenum standard, and since ATSDR has issued the final toxicological profile for molybdenum, Climax believes that it is more prudent to focus on the establishment of a scientifically-sound molybdenum standard at this time.

e. Stakeholder Outreach.

Since the July 2020 update, Climax has engaged in the following stakeholder outreach:

- October 7, 2020: Climax had a call with the Division, other CDPHE staff, and the EPA, to discuss the ATSDR molybdenum toxicological profile and potential next steps for a molybdenum standard in Colorado. This call instigated the Produce Study discussed in Section 4.b above.
- March 17, 2021: Summit Water Quality Committee meeting – Climax presented data and provided an update on the progress with the Division. The Summit Water Quality Committee includes many of the "Molybdenum Stakeholders."
- May 18, 2021: Community Partnership Panel – Climax presented on its progress with the Division on determining an appropriate standard. This group includes community members from Summit, Lake, Eagle, and Chaffee Counties.

Climax looks forward to hosting a stakeholder meeting (virtually, and/or in person if safe) later this year.

5. Update on Molybdenum Agriculture Standard

As noted in our July 2020 Update, Climax, together with Colorado State University (CSU), undertook a two-generation cattle study on pastures in Grand County and at CSU's facilities in Fort Collins to build on a previous study on the effects of molybdenum on cattle. This two-generation study began in mid-2018 and was completed in early 2020. There were 54 cow/calf pairs in 2018/2019 and 51 cow/calf pairs in 2019/2020. The study included six treatment levels. The highest molybdenum level was 1000 μg/L.

The purpose of the study was to provide additional information on how molybdenum in water influences cattle growth, reproductive performance, health, and copper

nutritional status. It also examined whether molybdenum in drinking water or feed affected molybdenum and copper metabolism differently.

Results from the study include:

- The animals showed no adverse effects in the two-year study.
- There were no visible or measurable molybdenum toxicity or copper deficiency signs (e.g., reduced growth, reproductive performance, or immune function).
- There was no significant difference between the control group (Mo = 0 µg/L) and the groups that received 500 µg/L and 1000 µg/L in their drinking water.
- Molybdenum in drinking water had less effect than molybdenum in diet.
- The Cu:Mo ratio in treatments with the highest concentration of molybdenum and lowest concentration of copper was approximately 1:1.

Aspects of the study have been published as follows:

- Thorndyke et al., 2019. *The influence of molybdenum in drinking water or feed on apparent absorption and retention of molybdenum and copper in beef steers*. Journal of Animal Science, Vol. 97, Suppl. S3, 423–424. https://doi.org/10.1093/jas/skz258.840.
- Thorndyke et al., 2020. *Molybdenum Exposure in Drinking Water Vs Feed Impacts Apparent Absorption of Copper Differently in Beef Cattle Consuming a High-Forage Diet*. Biological Trace Element Research. Online publication. https://doi.org/10.1007/s12011-020-02440-0.
- Thorndyke et al., 2020. *The influence of long-term molybdenum supplementation (in drinking water or feed) on beef calf performance through weaning*. Journal of Animal Science, Vol. 98, Suppl. 4, 436–437. https://doi.org/10.1093/jas/skaa278.761.

Further information on the study will be posted to the https://climaxmoinco.com/ website. Stakeholder meetings have been on pause since September 2019 to allow for the report to be completed; completion of the report was delayed due to the COVID-19 pandemic. The report should be completed soon, and will be posted on the Climax website, with a stakeholder meeting including Dr. Terry Engle (CSU) to be scheduled soon after.

6. Conclusion.

Climax will continue to work with the Division and stakeholders on next steps for advancing a proposal for a scientifically-sound water quality standard for molybdenum.

7. Appendices

A. Letter from IMOA to ATSDR, Re: US ATSDR Toxicological Profile for Molybdenum 2020 (Mar. 24, 2021)

   1. F. Jay Murray, Ph.D., Serious Limitations & Deficiencies of Fungwe et al. (1990) Study and the ATSDR Toxicological Profile for Molybdenum (2020) (Mar. 23, 2021)

   2. F. Jay Murray, Ph.D., Evaluation of the Intraspecies and Interspecies Uncertainty Factors and Modifying Factors Used by Regulatory and Scientific Organizations for Molybdenum and Other Essential Trace Elements (Mar. 23, 2021)

B. Summit County Produce Study

C. Graphs of Molybdenum Data

D. Colorado School of Mines Project Update