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Steve Bullock, Governor

Sheila Hogan, Director

October 28, 2020
Karen Sullivan
Health Director
Butte-Silver Bow Health Department
25 W. Front Street
Butte, MT 59701

Dear Ms. Sullivan

This letter provides interpretation of air quality data recently collected in Butte, Montana as requested by the Butte-Silver Bow Health Department. This letter is also a service to the residents of Butte who may be impacted. The Montana Department of Public Health and Human Services (DPHHS) provides this public health evaluation through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

In the spring and summer of 2019, Bison Engineering, Inc. on behalf of Montana Resources LLP, sampled particulate matter (PM) and the metals in air. The sampling event occurred under the auspices of the United States Environmental Protection Agency (EPA) Superfund Program. Based on our evaluation, these are some of the key findings and recommendations:

- After full review and analysis of the data, all average metal concentrations in the ambient air were well below health-based screening levels. The levels of these metals that are known to cause adverse health effects are most common in occupational settings and have various and wide-ranging effects.
- There were three exceedances for particulate matter that occurred on two separate days. Exposure to PM levels above these levels has the potential to trigger harmful health conditions, especially in highly sensitive populations (*e.g.*, asthmatics, children, and elderly). Some of these effects include respiratory symptoms and an exacerbation of cardiopulmonary effects; sensitive populations should consider reducing prolonged or heavy exertion on days that reach or exceed these levels. There were no days when short-term PM levels were of concern for exposures to the general population. Longer-term PM exposures, represented by the seven-month sampling period, were not above the World Health Organization's annual Air Quality Guidelines for PM indicating that the likelihood for harmful effects is low to the general population.
- It is recommended that the Butte-Silver Bow Health Department continue the effort to provide information to the public about the various resources available (e.g., Today's Air[1], managed through MT Department of Environmental Quality) so individuals can be aware of outside conditions and take appropriate action. Importantly, this letter only evaluated the available data which only covered part of the year which is a limitation of this evaluation. The following sections of this letter further describe the background of the site in and around Butte, the air quality results, and further interpretation of these results.

[1]Montana Department of Environmental Quality. 2020. Today's Air. Available at: http://svc.mt.gov/deq/todaysair/. Accessed on July 29, 2020.

Background

Butte has a long history of surface and underground mining activity that stretches back to the 1800s (EPA, 2020a). These mining activities resulted in wastes being dumped into areas in and around Butte, as well as into streams and wetlands near mining operations and smelters. Milling operations also produced large amounts of aerial emissions of metals. These activities went largely unchecked for nearly a century before environmental regulations emerged to protect the health and well-being of the public and their environment. In 1983, the EPA added The Silver Bow Creek/Butte Area site to the National Priority List (NPL).

Site characterization is ongoing through the Superfund program. Recent source apportionment studies in Butte provide a snapshot of which sources contribute to the particulates in ambient air. During summer months in 2013, a study reported that the sources of particulate matter were 72% wood smoke, 11.1% sand/road dust, 7.8% secondary sulfate, 5.5% ammonium nitrate, 1.3% automobile exhaust, and 2.4% unexplained/unaccounted (Ward, 2014). However, this study only looked at $PM_{2.5}$ sized particulates (particulates with a mean aerodynamic diameter ≤ 2.5 µm).

A review of available soil data also supports that various metals are within the range of typical urban areas (ATSDR, 2019). This review also investigated the city's water data and indicated that reported metal levels are within EPA regulatory standards (Secondary Maximum Contaminant Level) for manganese (EPA, 2020b), and guidelines (Maximum Contaminant Level Goal) for copper and zinc (EPA, 2019a). Further review of a recent manuscript (Hailer et al., 2017) containing soil data for various metals (*i.e.*, copper, manganese, zinc, arsenic, cadmium, cobalt, chromium, lead, antimony, and selenium) indicated that reported soil levels were all well below the EPA's November 2019 Regional Screening Levels (RSLs) for ingestion of metals (EPA, 2019b).

Inhalation is one of the most common ways individuals are exposed to toxic substances. Therefore, examining this exposure pathway is an important step for identifying possible community-wide hazards. As with any other community, ambient dust in the air in Butte comes from a variety of sources. The metals reported by Bison Engineering, Inc. include arsenic, cadmium, copper, manganese, molybdenum, lead, and zinc. Except for molybdenum, all these metals are also considered chemicals of concern (COC) for the Butte Superfund site (BSBHD, 2012).

Community Health Concerns

A recent survey provided insight into the community's perceptions about exposure risks and potential for adverse health effects (Nagisetty et al., 2020). One response category exhibited a continued concern about health risks related to Superfund activities. Also, as reported in the local media (McCumber, 2019; De Leon, 2020), recent studies have emerged that may have caused many in the community to worry about continued exposures.

Environmental Sampling

Mass concentrations of total suspended particulates (TSP) and PM_{10} (particulate matter with a mean aerodynamic diameter ≤ 10 µm) were determined as well as their levels of various metals (*i.e.*, arsenic, cadmium, copper, manganese, molybdenum, lead, and zinc). The data include March 2019 through September 2019 (4^{th} quarter data are forthcoming). Collection of these samples was collocated at the same air monitoring station where the municipality collects continuous air data for priority pollutants as mandated by the Clean Air Act. The air monitoring station is located at a closed elementary school in a residential neighborhood on the north side of Butte and near an operating open pit copper mine. One of these priority pollutants is $PM_{2.5}$ where mass concentrations are continuously monitored and recorded throughout the year. This station is also part of the $PM_{2.5}$ Chemical Speciation Network whereas separate $PM_{2.5}$ sampling also occurs every six days (following the EPA's fixed monitoring schedule at the Butte-Greeley school). These samples are speciated (*i.e.*, chemically analyzed to determine constituents of the particulates) following the EPA's Chemical Speciation – Laboratory Standard Operating Procedures for quality and validation (EPA, 2018) providing similar measures as those provided by Bison Engineering, Inc. Therefore, DPHHS was able to evaluate all three particulate size classes.

The TSP and PM_{10} data were collected from the contractor, Bison Engineering, whereas the $PM_{2.5}$ data was collected by the municipality as required by the EPA. Due to there being two separate parties collecting and reporting particulate information, including the various analytical instrumentation used, typical variations in approach and quality control can create challenges when directly comparing the $PM_{2.5}$ data with PM_{10} or TSP data, especially when values are mostly low. Nonetheless, we have included Butte's reported $PM_{2.5}$ mass concentrations and metal concentration data from the EPA's chemical speciation network (EPA, 2020c) for comparison. TSP, PM_{10}, and $PM_{2.5}$ mass concentration units are reported in $\mu g/m^3$ (micrograms of metal per cubic meter), and all metal concentration units are reported in ng/m^3 (nanograms of metal per cubic meter). Standard deviations were calculated from the weekly data provided by Bison for TSP and PM_{10}. Standard deviations for $PM_{2.5}$ are as reported by the EPA (EPA, 2020c).

Comparison Values

All referenced concentration values used for screening data will be generally referred to as Comparison Values (CVs) unless otherwise specified (e.g., ATSDR CVs). The evaluation relies on the most conservative (protective) CVs, selected from various agencies, most of which apply to chronic exposure. Acute exposure CVs were also included for screening PM_{10} and $PM_{2.5}$ 24-hour averages.

For assessing health risks, the EPA National Ambient Air Quality Standards (NAAQS) were used for TSP mass concentration measures, and the Air Quality Guidelines (AQGs) established by the World Health Organization (WHO) were used for PM_{10}, and $PM_{2.5}$ mass concentration measures. Note that the TSP mass CV is a historical standard, and it is only used as a reference here. There have been no updated TSP standards since 1971 because the EPA determined that PM_{10} and $PM_{2.5}$ were better indicators of potential harmful effects. The CVs (*i.e.*, NAAQS and AQG, respectively) for TSP and PM are 260 $\mu g/m^3$ for TSP, and 50 $\mu g/m^3$ and 25 $\mu g/m^3$ for PM_{10}, and $PM_{2.5}$, respectively and are based on 24-hour averages. There are also AQG recommendations for annual means for PM_{10} and $PM_{2.5}$ at 20 $\mu g/m^3$ and at 10 $\mu g/m^3$, respectively. Also, EPA has a primary standard for $PM_{2.5}$ at 12 $\mu g/m^3$ which is based on an annual mean, averaged over three years. These guidelines and standards are at levels that are geared to protect public health, including the most sensitive populations, *e.g.*, asthmatics, children, and the elderly (EPA, 2016; WHO 2006).

The CVs used for assessing the various metals are as follows: ATSDR CVs were used for cadmium (10 ng/m^3) and molybdenum (400 ng/m^3); California's Recommended Exposure Limit (REL) was used for arsenic (15 ng/m^3); Michigan's Reference Concentration (RfC) was used for copper (2000 ng/m^3); and EPA's Regional Screening Levels (RSLs) were used for manganese (300 ng/m^3) and lead (150 ng/m^3).

As well as being protective to those populations that are more sensitive (*e.g.*, children and elderly), these CVs also account for long-term chronic exposures (*i.e.*, $\geq$ 1 year). The nature of exposure is expected to be variable over these long periods. Therefore, DPHHS compared CVs to average concentrations of measured metals in the environment to better represent the distribution of possible exposures. Note that these specific CVs are not meant to assess acute exposures (*i.e.*, exposures lasting $\leq$ 14 days).

For zinc, studies are limited, and an ATSDR screening value has not yet been derived. According to the literature, the lowest levels that showed no adverse effects ranged from 34 – 4,600 $\mu g/m^3$ (ATSDR, 2005b). Even though there were no CVs for zinc, the ambient levels in Butte were still thousands of times lower than those reported to cause adverse health effects in occupational settings (Blanc, et al., 1991; Hammond, 1944; Sturgis et al., 1927). Importantly, zinc is an essential nutrient and people are normally exposed to zinc in their diet and in their environment (ATSDR, 2005a). Also, EPA speciation data in Helena (EPA, 2018) indicates that $PM_{2.5}$ zinc average levels were about 2.1 ng/m^3 for 2018, which is similar (± 10 ng/m^3) to Butte levels. For comparison, Helena and Butte are similar cities in terms of socio-demographics and population density. Also, Helena and Butte are less than 48 miles apart.

Results

Particulate concentrations (TSP, PM_{10}, $PM_{2.5}$)

Table 1 shows the average daily concentrations from March 2019 through September 2019 with the associated highest and lowest measure for that month. For all three size fractions and throughout all three quarters, only 3 occurrences of the 24-hour period's average concentrations met or exceeded the AQG 24-hour guideline which occurred on two different days. The first was on March 5th (PM_{10} and $PM_{2.5}$ had 24-hour average concentrations of 50 µg/m^3 and 27.1 µg/m^3, respectively) and again on May 31st ($PM_{2.5}$ had a 24-hour average concentration at 27.0 µg/m^3). Also, there were no indications that the primary standard for $PM_{2.5}$was exceeded. Also, even though it is not an entire year's worth of data, the available data were averaged to assess if these levels exceeded the annual standards for PM_{10} and $PM_{2.5}$ (20 µg/m^3 and 10 µg/m^3, respectively) and the resulting averages (17.4 µg/m^3 and 4.0 µg/m^3, respectively) did not exceed these levels.

The CVs are aimed at decreasing the potential for harmful health effects in sensitive populations, including respiratory symptoms and an exacerbation of cardiopulmonary effects. We would not expect harmful effects to the general population for exposures over these two days. However, there may be harmful effects in sensitive populations. Nevertheless, we would not expect harmful health effects to either the general public or sensitive persons based on longer-term exposures represented by the 7-month average. There may have been other days outside this 7-month range that had levels of concern for various populations, including the general public.

The reported TSP concentrations are very similar to the reported PM_{10} concentrations. This means that the TSP likely contains a small fraction of particulates that are greater in size than PM_{10}. For the first month, March PM_{10} values were slightly higher than the TSP. This is likely an artifact of the various sampling and analytical approaches used for the various size fractions.

Table 1. Average daily concentrations of TSP, PM_{10}, $PM_{2.5}$, and their ranges, including non-detects (ND)

	Average mass concentrations for Q1, Q2, and Q3 (µg/m^3), and the lowest (l) and highest (h) 24-hour measures		
Collection period	***TSP (l - h)**	**PM_{10} (l - h)**	**$PM_{2.5}$† (l - h)**
Q1 (March)	24 (ND - 46)	26 (ND - 50)	9.7 (0.1 - 26.9)
Q2 (April)	15 (ND - 28)	14 (ND - 27)	2.0 (ND - 5.4)
Q2 (May)	18 (ND - 98)	13 (ND - 43)	2.7 (ND - 27.1)
Q2 (June)	16 (6 - 26)	13 (6 - 19)	1.9 (ND - 7.3)
Q3 (July)	25 (13 - 43)	21 (11 - 40)	4.8 (3.1 - 6.6)
Q3 (Aug)	17 (7 - 28)	19 (8 - 32)	4.3 (1.9 - 9.7)
Q3 (Sept)	15 (4- 32)	16 (4 - 32)	2.7 (ND - 9.8)
NAAQS 24 hr (µg/m^3)	**260**	**NA**	**NA**
WHO AQG 24 hr (µg/m^3)	**NA**	**50**	**25**

NA = Non-applicable
* TSP standard replaced by PM_{10} in 1987.
† $PM_{2.5}$ data are as reported by the EPA and was not derived from the same unit that collected and reported PM_{10} and TSP data.
NAAQS = National Ambient Air Quality Standards
WHO AQG = World Health Organization Air Quality Guidelines

Metal Concentrations (mass of metal/m³)

Table 2 shows the average concentrations of metals reported in the various particulate size fractions (i.e., TSP, PM_{10}, and $PM_{2.5}$). For all metals none exceeded their respective chronic CV.

Table 2. Average concentrations and standard deviations (sd) of metals in TSP, PM_{10}, and $PM_{2.5}$, and their associated CVs.

	Average Metal Concentrations (ng/m³)			CV	CV Source
	TSP (sd)	PM_{10} (sd)	$PM_{2.5}$ (sd)*		
Arsenic	3.2 (3.7)	2.5 (1.8)	0.0 (0.0)	15	CA REL
Cadmium	0.32 (.36)	0.28 (0.18)	2.15 (7.76)	10	ATSDR MRL
Copper	55.4 (32.6)	51.0 (50.6)	4.9 (4.3)	2,000	MI RfC
Manganese	16.1 (9.7)	19.8 (14.2)	1.2 (2.9)	300	EPA RSL
Molybdenum	3.7 (2.7)	4.9 (5.2)	-	400	ATSDR MRL
Lead	34.5 (123.6)	5.7 (7.5)	1.8 (5.2)	150	EPA RSL
Zinc	41.8 (48.0)	30.7 (20.8)	10.7 (12.2)	-	-

* $PM_{2.5}$ data is as reported by the EPA and was not derived by the same unit that collected and reported PM_{10} and TSP data.

Conclusions

For all average metal concentrations in the ambient air, none exceeded health-based screening levels.

Zinc levels in Butte were similar to those measured in Helena. Also, levels in Butte were far lower than those known to cause adverse health effects (ATSDR, 2005b). Taken together, there is no evidence that reported zinc levels, or any other metal reported here, are at levels known to be hazardous to human health.

There were three exceedances for the PM_{10} and $PM_{2.5}$ 24-hour AQGs (that occurred on two different days). Exposure to PM levels above the AQG has the potential to trigger acute health conditions in highly sensitive populations (*e.g*., individuals with asthma, children, and the elderly). There were no days when short-term PM levels were of concern for exposures to the general population; longer-term PM exposures, represented by the seven-month sampling period, were not above the World Health Organization's annual Air Quality Guidelines for PM indicating that the likelihood for harmful effects is low throughout all populations.

Recommendations

Highly sensitive people and parents of highly sensitive children should consult with the air quality forecast, including the real time reporting available online (http://svc.mt.gov/deq/todaysair/), and consider reducing prolonged or heavy exertion on days where air quality is poor.

Montana DPHHS recommends that Butte-Silver Bow Health Department share these conclusions with the community. There are no other actions recommended at this time.

Montana DPHHS also trusts that this report will be of help as you continue to navigate the concerns of the community and work to identify other potential sources of exposure that the community is concerned about. If you have any additional questions, or need assistance in community communications, please contact our office within the Public Health and Safety Division at DPHHS.

Sincerely,

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