Review of
Draft Report: Donlin Gold Mine
Supplemental Mercury Modeling and Mass Balance Analysis
By Ramboll U.S. Consulting, Inc.

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This report consists of a review of the Draft Report: Donlin Gold Mine Supplemental Mercury Modeling and Mass Balance Analysis, by Ramboll US Consulting Inc. I have worked on mercury issues while on the faculty of the University of Nevada for several years and studied this issue in detail during a 2006 study on mercury management in gold mining funded by the U.S. EPA. I was also involved with continuing discussions on the development of a mercury management policy and regulations over the last 20 years by the Nevada Division of Environmental Protection.

In brief, I found the post EIS mercury report on the Donlin mine to be problematic, often difficult to follow and, potentially, an example of goal-modelling a contaminant release that is designed to meet some regulatory standard. Modeling requires consideration of a variety of factors, which can often result in a very wide variety of predictive outcomes. For the mercury report I feel that the authors of the study made modelling assumptions that were focused on predicting minimum mercury releases and water concentrations that would provide a rationale that would support permitting the mine.

The Donlin Mine has a substantial load of mercury in the ore and is predicted to produce 34,600 lbs (15.7 metric tons, depending on which ore concentration is used) of byproduct mercury annually. Using the reports of the byproduct mercury produced in Nevada in 2020, if this mine was in Nevada, it would be the second largest producer of byproduct mercury in the state, after the Nevada Gold Company's (Barrick), Goldstrike mine. This latter mine released 617 lbs of mercury to the atmosphere from thermal sources in 2020 (NDEP, 2021), which is the largest amount of mercury released in 2020 from thermal sources (not including fugitive sources) in mines of Nevada. To report that only 30 kg (66 lbs) (total from both thermal sources and fugitive emissions sources) would be released from the Donlin mine strains credibility. While the information presented in the Donlin supplemental report does not provide adequate information to understand where those data originated, sufficient evidence exists to suggest that the post FEIS predicted emission rate is low and unreliable, and supports the contention that the goal of the study was to show an unrealistically low mercury volatilization. At the very least the information that is available contains variables that have a large amount of uncertainty, and there is no basis for arguing that the revised estimates of mercury release to the atmosphere are reliable.

I will focus on the two issues of mercury emissions from the tailings facility and the thermal sources, which are the expected single largest sources of mercury emission from the Donlin mine. The report relies on the research reported in the article by Eckley, et al. (2011), which is one of the very few studies that focused on fugitive emissions from non-thermal sources from a mine.

1. **Emissions from tailings:** This study (Eckley, et al., 2011) was conducted under the direction of Dr. Mae Gustin, who has an international reputation in the general area of mercury transport and is highly respected. Her laboratory and staff initiated a study around 2006 that focused on mercury emissions from fugitive emissions from a mine site. I was aware of this study and was

on the Nevada Division of Environmental Protection (NDEP) committee that selected her laboratory as the recipient of the research grant. I have reviewed the article previously. The primary source of mercury emissions from these non-thermal sources was the tailings facility, with active heap leach operations the second largest source. The Donlin mine is not projected to have heap leach operations, and the primary source of nonthermal mercury emissions from the proposed mine is the tailings facility.

I offer a background on the mercury chemistry associated with cyanide, which relates to an uncommon series of reactions that are rare in the environment, but very common in gold mines. The thermodynamic data on cyanide and mercury are provided in a U.S. Bureau of Mines "Information Circular" published in 1995 Flynn and Haslem, (1995). This information, however, does not appear to be present in the common geochemical models, probably since the reactions of cyanide and mercury are important only in the gold mining industry, or in other applications that use cyanide, which are uncommon in the non-mining environment. In general, mercuric ion has a low solubility and sorbs onto particle surfaces strongly and is not expected to have a high concentration in environmental waters. But, in water containing sufficient amounts the cyanide ion, high soluble mercury loadings in tailings facilities and operating heaps are common and associated with a complex of mercury and cyanide.

Cyanide is the most common lixiviant (extraction reagent) for removing gold from ore. Cyanide ion reacts with oxygen and gold to form a water soluble complex, gold cyanide ($Au(CN)_2^{-1}$). Because it is an ion, the gold cyanide complex is water soluble and can be captured from water by passing it over charcoal. Mercury contains a similar chemistry. In the presence of various forms of mercury (including cinnabar, HgS), it can be oxidized (when necessary) and reacts with mercury to form a mercuric dicyano complex ($Hg(CN)_2$) or, at higher concentrations of cyanide forms a complex with three or four cyanide ions. While $Hg(CN)_2$ is not ionic, it has a high solubility in water of 80-90 grams/L (8-9%) (Flynn and Haslem, 1995), and the ionic forms of cyanide with 3 or 4 cyanide ions in the complex are also very soluble in water.

Using examples from heap leach systems, the concentration of mercury in the operating heap leaching fluids from Eckley, et al., (2011) study was 0.47 mg/L. Another example of mercury content in heap fluids is presented in a study from Peru (Matlock, et al., 2002) which showed mercury concentrations of 34.5 mg/L in a heap treated with cyanide. While a direct comparison of heaps to tailings has some uncertainty associated, the concentrations of cyanide used in heaps are similar (in general) and the charcoal treatment of the extraction fluids is also similar- both the gold cyanide and mercury cyanide complexes are largely removed from solution. Thus, it is reasonable to expect that the mercury concentrations in tailings fluids are much elevated compared to the predicted concentrations of mercury in water without cyanide.

While the FEIS mentioned cyanide as a problematic contaminant if water was discharged to surface water, no discussion of mercury cyanide interactions was provided. Also in the post FEIS report, no mention was made of how cyanide will affect dissolved mercury concentrations, and this lack of discussion alone suggests that the report is deeply flawed.

From the Twin Creeks Mine (operated by the Nevada Gold Company- Barrick is the operator) for recent quarterly reports (NDEP, 2021), the amount of mercury in the tailings is dependent on the cyanide concentrations (indicated as weak acid dissociable cyanide- WAD cyanide). When the WAD cyanide concentration was either 8.27 mg/L or 0.65 mg/L, the mercury concentrations dissolved in water were 0.506 mg/L and 0.118 mg/L. But if cyanide concentrations were less than 0.05 mg/L, the mercury concentrations were less than 0.001 mg/L. Interestingly, the two high mercury concentrations were in November and March (2020 and 2021), while the low concentrations of mercury were observed in July and June (2020 and 2021). This is consistent with the photochemical loss of mercury in the summer months. However, the variable concentrations of mercury in the Twin Creeks tailings facility from a mine that produced 2.4 metric tons of byproduct mercury in 2020 suggests that, at the least, use of a calculated concentration 0.073 mg/L of mercury in the Donlin projected tailings from the post FEIS report is too low, particularly since the Donlin mine is expected to produce over 15.7 metric tons of byproduct mercury on a yearly basis, and a substantial, but unknown amount will also be released to the tailings facility.

Also, recent data from the Barrick Goldstrike Mine first quarter 2021 (NDEP, 2021) report for the North Block tailings filtrate (liquid sample) (NDEP, 2021) indicated that the mercury concentration was 0.8 mg/L with a WAD cyanide concentration of 23 mg/L. The North Block tailings permit allows Barrick to process 24 million metric tons of ore per year, similar to the Donlin ore projection of 21.5 million metric tons.

For both large mines in Nevada, the mercury content in the tailings fluids was shown to be related to the cyanide concentrations. When cyanide is present in the tailings fluids (which is almost always the case when discharged), mercury concentrations will become elevated. This will also be the case for the Donlin tailings facility. This factor was not included in the post FEIS mercury report, nor was the issue of cyanide mobilization of mercury even mentioned.

The mercury content in tailings water is a function of cyanide content, and cyanide concentrations will decrease as pH is decreased or as time has evolved. As cyanide is lost, the mercury will become mercuric ion (Hg^{2+}) which will sorb to the solid spent ore. Additionally, the mercury content in the tailings is almost certainly not uniform over the entire tailings pond, since cyanide content will change when exposed to air, and the cyanide is volatilized. Additional studies should be performed on this issue, although it remains unclear how rapidly these concentrations change. The expectation is that the highest concentration of mercury in the tailings will be at the point of discharge of tailings transferred into the tailings pond.

Perhaps the most confusing statement is how the concentration of mercury in the tailings was determined. The statement on page 3-12 of the Ramboll report:

> "**3.2.2.1 TSF Pond Mercury Emission Flux**
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> The methodology to estimate mercury emissions from the inundated tailings pond assumes a linear dependency between mercury emission flux and mercury solution concentration. The FEIS used a pond mercury concentration of 0.315 mg/L which was derived from the measured mercury concentrations in tailings material (0.00004 mg/L for liquid and 0.7 g/ton for solid) and other process parameters from the Feasibility Pilot Study (2007 Phase 2; SRK, 2012), namely, a tailings slurry water percentage of 64% and solids and slurry specific gravity of 2.76 and 1.25, respectively.
>
> In this analysis, updated information on the tailings concentration that became available since the modeling exercise to support FEIS development (Environ 2015) was used. Specifically, the updated Water Resources Management Plan (WRMP; SRK

2017) provides a soluble mercury content of 0.073 mg/L derived from geochemical modeling of the tailings filtrate water from the Feasibility Pilot Phase 2 study.[10]

It is unclear how the 0.073 mg/L concentration in the tailings fluid was determined but is perhaps related to the use of a geochemical model to predict mercury concentrations in water and based on the concentration on solid material. The mercury concentration in the tailings fluid does not appear to recognize the importance of cyanide and the formation of the very soluble mercury cyanide. Even in the Eckley, et al., (2011) study, the concentration of mercury in the circulating Twin Creeks heap fluid was 0.47 mg/L. Using the 0.00004mg/L mercury concentration from the FEIS is almost certainly incorrect, although it was not clear where the data originated. The concentration of 0.073 mg/L mercury in the tailings facility in the revised report is also almost certainly low. I question whether the thermodynamic parameters for mercury cyanide were even available in the geochemical study, and if those values were not incorporated into the calculation any calculations of mercury concentrations using standard non-cyanide geochemical models in water containing cyanide are ***not*** reliable and may be off by orders of magnitude.

The Eckley and coworkers study (2011) discusses the importance of sunlight on emission of mercury from the tailings fluids. Indeed, mercury is converted from other forms to the volatile elemental form under irradiation and is emitted as elemental mercury. The Gustin laboratory has demonstrated this commonly (see Eckley, et al., 2011 and references quoted in that publication). But this conversion is not through direct photolysis, since $Hg(CN)_2$ is transparent to sunlight wavelengths (Flynn and Haslem, 1995). Thus, the alternative mechanism is that there is some indirect photochemical process in which sunlight excites some other substance and initiates a series of reactions that result in conversion to and emission of Hg^0.

Modelling this process is difficult, since it is not known how this mechanism works, or what the sunlight-absorbing substance is. Additionally, it is unclear how mercury is brought to the surface to be exposed to these reactions, although evaporative flux of water may be involved. Our laboratory demonstrated that evaporative process can bring substances to the surface by evaporative “wicking” of water from below the immediate millimeter of sunlit particle surface and can undergo photochemical reactions (Donaldson and Miller, 1996). This suggests that if water is present in the tailings, it can move the water-soluble mercury cyanide species to the surface also, where they are photochemically converted to the volatile elemental mercury. The argument that the study makes is that since dry surfaces do not move water to the surface, and contribution to mercury loss from dry tailings can be ignored. But there are no data presented for examples in the central part of Alaska. Nevada summer dry is probably much drier than Alaska summer dry, and it appears that using the example of Nevada may not have applications to Alaska conditions during the summer months. At the least, use of Nevada dry for Alaska dry has no data to support this conjecture.

The Eckley et al., (2011) study measured the emission from the Twin Creeks tailings facility at 63 kg/year, and the Ramboll US Consulting report estimated the mercury emissions from the Donlin mine to be 7.5 kg/year. Ultimately, the combination of a much higher mercury content in tailings from the Donlin Mine and the larger tailings surface area suggest that the mercury volatilization from the tailings is dramatically underestimated. I do not know how much mercury will be emitted from the Donlin Tailings facility, but the concentration of mercury in the tailings facility will be higher than the 7.5 kg/year estimated in the mercury report.

Ultimately, a portion of the mercury release from the tailings facility will be transferred to the surrounding watershed and be available to the regional streams and biota. Once it is present in the local area, it will effectively be an increased source of mercury for the foreseeable future.

2. **Emission of mercury from thermal sources.** The mercury present in the ore is quite high, and the byproduct mercury projected to be recovered is 34,600 lbs (15.7 metric tons) and would make the Donlin mine (if located in Nevada) the second largest producer of byproduct mercury in the state (and perhaps in the nation). The largest producer of byproduct mercury in Nevada in 2020 was Barrick's Goldstrike mine at about 130 metric tons, with most of it likely captured in emission control systems on the roasters. It is also the largest measured atmospheric emission source of mercury from a gold mine at 280 kg, most of which was emitted from the roasters (NDEP, 2021). Unlike the Goldstrike mine, the Donlin mine will not have ore roasters, but will have autoclaves for oxidation of the ore. Mercury is generally retained in the high-pressure autoclaves and is processed along with the gold cyanide as mercury cyanide. Both cyanide complexes will be removed at least in part from the process fluids and captured on activated charcoal. Further processing of both cyanide species will remove gold and mercury from the carbon, convert both metals to elemental forms in the electrowinning circuit, and ultimately, the now elemental mercury will be boiled off from gold in retorts and captured as elemental liquid mercury. These latter processes are critical when estimating the mercury that will be released into the atmosphere.

   The EIS indicates a high removal of mercury (Table 2.3-2), but this removal efficiency, as a percentage, is less than what is stated as actually being removed.

Table 2.3-2: Mercury Control Efficiency

Mercury Control Point	Mercury Removal Efficiency
Pressure oxidation;	99.9%[1]
Hot cure	99%[2]
Electrowinning	99%[1]
Retort	99%[1]
Refinery furnace;	99%[1]
Carbon regeneration kiln	99%[2]

Source: [1]SRK 2014a, [2]Hatch 2014

Compared to efforts prior to 2000, many of which were ineffective in removing mercury from emissions, this removal efficiency appears to be generally good. These constitute the primary sources of mercury released to the atmosphere from thermal sources, and if we assume that the 99% efficiencies are correct, we also read that the amount of mercury collected per year from the waste stream will be 34,600 lbs (15,700 kg; 15.7 metric tons) of mercury per year. Even if we believe this high efficiency (99%), that means that 1% of 34,600 lbs is 346 lbs of mercury (157 kg) will be emitted, which is well above what the recent report indicates will be released, which is a meager 16 kg (Table ES-1). While the pressure oxidation process is 99.9% efficient in capturing the volatilized mercury, almost all of mercury recovered from the ore will ultimately be processed sequentially through electrowinning, retort and refinery furnace processes which, as indicated in the updated mercury report, will all be 99% efficient. If 99% is multiplied by itself 3 times, this gives a recovery rate of slightly over 97%, which is around 3 % loss of mercury to the atmosphere (around 452 kg) in the thermal processes.

But let's stay with the 157 kg/year. How do these processes reported in the study compare with Nevada actual measured emissions? The same company, Barrick, is emitting a total of 617 lbs (280 kg) of mercury in 2020, although most of it is emitted in the roaster processes (NDEP 2021). I will agree that the Goldstrike Mine is doing a good job in collecting mercury, in that this same mine collected 130 metric tons of mercury as a byproduct (NDEP, 2020, attached to this report). The production of mercury at the Donlin Mine (see above) is predicted to be 15.7 metric tons of byproduct mercury (not perhaps correct- see below due to changes in mercury content in the ore), most of which will be processed from mercury cyanide, along with the gold cyanide. While we cannot assume linearity of capture efficiency, we do *not* find it credible that only 16 kg/year (or 15.9 kg/year in another section of the report) will be released from the thermal sources, which suggests a greater than 99.8% efficiency, and is better than the EIS reported 99% efficiency for the mercury capturing processes considered, even ignoring the release from the autoclaves.

Additionally, there was really very little information presented on how the 16 kg/year figure was obtained other than the table 2.3-2, and the information in that table suggests a greater emission of mercury than the 16 kg reported. There is no question that mercury control in the mining industry has improved in the last 20 years, but the 16 kg/year number is not based on actual measurement but is apparently based on emission factors from the companies making the control equipment, and from some of the operating facilities.

In fact, the post-FEIS Ramboll US Consulting report clearly has points in error. If we use the 1.62 mg/kg of mercury content in the ore from the FEIS, and assume that effectively all of the mercury processed is collected and 21,535,000 tons/year of ore is processed, the amount of mercury in the ore is 34,600 lbs (15.7 metric tons). Effectively all of mercury will go through the processing facility, which is very close to the 15.7 tons that the FEIS and the Ramboll report indicates will be collected. Now, the Ramboll US Consulting report uses a different number for mercury in the ore of 1.27 mg/kg, and if we use the same number of ore processed, 21,535,000 tons, the total amount of mercury that will be processed is 27,300 lbs (12.4 metric tons), which is less than in the FEIS. This is not a trivial difference and is largely unexplained. Even if this amount is used as the total amount of mercury processed in the cyanide circuit and collected, it would still be a very large amount of mercury. This difference also points to the uncertainty of mercury management at gold mines. The highly variable amount of mercury collected from the Barrick Goldstrike Mine also indicates the high variability of mercury managed each year, from 111,000 lbs in 2013 to 326,000 lbs in 2018 (NDEP mercury emission report 2021), a factor of 3 difference within 5 years.

As indicated above, the largest mercury byproduct production from a gold mine in the U.S. is from the Barrick Goldstrike mine (and associated facilities) in Nevada. In 2020 this mine released approximately 60 lbs of mercury into the atmosphere from the thermal sources (other than the roasters, which were the largest emitters of mercury) (NDEP mercury emission report, 2021).

According to the NDEP mercury emission report for 2020, approximately 12 million tons of ore was roasted, and the large percentage (nearly complete) of that mercury was volatilized from the roasters and ultimately captured in mercury emission control systems on the roasters. An additional 14.9 million tons was sent through the autoclaves, which are similar to the ore processing facilities that will oxidize the ore at the Donlin Mine. Since these are high pressure oxidations, the amount of mercury released directly from the autoclaves is a comparatively smaller percentage than from roasters. This mercury is largely contained in the process fluids in the down stream gold recovery process. The measured amount of mercury emitted from the autoclaves, carbon kilns, laboratory etc., at the Goldstrike Mine was 60 lbs (27 kg). As indicated previously approximately 21.5 million tons of ore will be processed through the autoclaves at the Donlin Mine, which is approximately 30% more autoclaved ore compared to the Goldstrike Mine.

The 60 lbs (27kg) of mercury emitted from the Goldstrike Mine autoclaved ore is based on actual measurements, rather than emission factor estimates, and have higher reliability than the projected numbers. Again, the Donlin Mine is likely to emit at least 60 lbs of mercury, and perhaps more, since 30% more ore is being subjected to the autoclave based process. I would argue that the emissions from a similar operation (Goldstrike) is a better estimate of mercury emissions from the Donlin Mine than is the projected emissions using calculated factors. While the difference of 27 kg versus 16 kg of mercury emitted is not large, the ultimate amount of mercury released into the environment is close to the actual limits that can cause ecotoxicology problems, and the uncertainty of the estimates requires a conservative and valid analysis of the risk it may pose.

The mercury management at the Donlin Mine is predicted to be the best in North America, without any actual measurements made, or the continual process of improvement that mines in Nevada have undergone, even though it will be managing more mercury and producing more mercury than any gold mine in North America, except for the Barrick Goldstrike mine. This prediction strains credibility that this mine will be better than any existing mine simply based on highly optimistic expectations.

Under any circumstances, these numbers are all highly uncertain, and it is well established that 100% of mercury is not collected in the processing facility. In fact, the percentage of mercury collected is very likely less than the percentage of gold recovered, and the amount of mercury released into the tailings facility is unknown and could be more than 10% of the total amount of mercury processed. As discussed previously the mercury content in the ore is relatively high, and the total amount of mercury discharged into the tailings facility is also going to be high. Any model that expects that only 7.5 kg will be released (volatilized) from the tailings facility is deeply flawed, particularly since the model input components and their fate in the tailings facility are very much unknown.

Overall, we assume that the mercury control system may use some of the best available technology, but this report does not provide even minimal information that would suggest that only 15.9 kg will be released during the mercury control processes that will be used. The predicted 15.7 metric tons of mercury to be processed and collected is 1000 times more than what they suggest will be emitted, and this very low amount of mercury released to the atmosphere strains the credibility of the assertions.

In reality, the amount if mercury that will be discharged to the atmosphere from the Donlin Mine is truly fraught with uncertainties and includes the following:

- The mercury content in the tailings is dependent on the cyanide concentrations, and the time-varying concentration of cyanide are largely unknown. As indicated in the data from Twin Creeks, concentrations of cyanide at the Donlin tailings facility will very likely vary, depending on time of year, temperature and amount of sunlight.

- The mechanism of sunlight induced mercury release is largely unknown, although it is not direct photolysis. The wavelength distribution of sunlight at the Twin Creeks facility is substantially different than what is expected at the far northern latitude of Donlin, which is very likely going to impact both the cyanide concentration and the conversion of mercury cyanide to a volatile form.

- No reliable information is presented on the expected mercury concentrations in the Donlin tailings facility, particularly the amount of mercury released from the milling process and how those concentrations will change as the cyanide concentrations change.

- The amount of mercury collected as byproduct mercury is suggested to be near quantitative of the mercury in the ore. This is unlikely to be the case, since mercury cyanide capture on charcoal is largely unknown, at least in the public literature. Since at least three forms of mercury cyanide are known, there is really no data on how each form will be retained. These capture rates will affect the amount of mercury that is discharged to the tailings facility.

- The mercury content in the ore has been reduced by 20% from 1.62 mg/kg in the FEIS to 1.27 mg/kg in the Ramboll report. The mercury load in the ore is, however, high, and almost all of the mercury will be processed through the same steps that gold will undergo and be subject to emissions, both in the processing components as well as the tailings facility.

- The low prediction of processing emissions is unlikely, since the mercury capture systems are complicated and subject to releases of mercury at many steps in the process. There is no indication that the mining company will measure those emission rates (similar to what is required in Nevada mines), and simply stating what the emissions are predicted to be is less reassuring than if those emission rates are measured on a regular basis.

Both the fugitive emissions from the tailings facility and the emissions from the thermal sources appear to be substantially underestimated, and the resulting receiving waters are likely to have greater concentrations during and after the Donlin Mine is closed. While this review did not focus on the processes that will deliver mercury to surface waters from soils, it is generally the case that higher concentrations of mercury in the surface soils will result in higher amounts of mercury delivered to the streams in an approximately linear fashion. Clearly, a good portion of the mercury is sorbed onto the surrounding soils and geologic material, but, additional mercury released from the mine will definitely increase the amount of mercury delivered to surface water. Thus, twice as much mercury released from the mine will result in approximately twice as much mercury released to streams.

An area of critical concern is that once the mine is constructed and operated, and if concentrations ultimately exceed the water quality standards, removing the mercury from the surrounding lands will be effectively impossible.

References

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Eckley, C.S., Gustin, M., Miller, M.B., and Marsik, F., (2011), “Scaling Non-Point-Source Mercury Emissions from Two Active Industrial Gold Mines: Influential Variables and Annual Emission Estimates”, Environ. Sci. Technol., 45, 2, 392–399.

Flynn, C.M., and Haslem, S.M., (1995), “Cyanide Chemistry- Precious Metals Processing and Waste Treatment”, U.S. Bureau of Mines, information Circular, U.S. Department of the Interior.

Matlock, M.M., Howerton, B.S., Van Aelstyn, M.A., Nordstrom, F.L., and Atwood, D.A., (2002), “Advanced Mercury Removal from Gold Leachate Solutions Prior to Gold and Silver Extraction: A Field Study from an Active Gold Mine in Peru”, Environ. Sci. Technol., 36, 7, 1636–1639.

NDEP, (2021), “Mercury Emissions to the Atmosphere from Gold Mines in Nevada.” Available from the Nevada Division of Environmental Protection.

NDEP, (2021), Data from quarterly reports (Twin Creeks Mine and the North Block Tailings report) submitted to the Nevada Division of Environmental Protection and accessed in November, 2021.

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Education:

University of California, Santa Barbara, CA	B.S. Chemistry	1972
University of California, Davis, CA	Ph.D. Agricultural Chemistry	1977

Employment:

Univ. of Nevada, Reno	2018-present	Professor Emeritus
	2008-2009	On leave for 11 months serving as Manager, Environmental Exposure Assessment, Valent USA Corporation, Science and Engineering Walnut Creek CA
	2007-2008, 2010-2018	President UNR Nevada Faculty Alliance
	1995-2006, 2010-2014	Director, Graduate Program in Environmental Sciences and Health
	1998-2004	Director, Center for Environmental
	1989-2018	Professor
	1983-89	Associate Professor
	1979-83	Assistant Professor
	1978-79	Lecturer
Environmental Protection Agency	1977-78	Research Chemist

Professional Societies:

American Chemical Society, Agrochemicals Division and Environmental Chemistry Division
American Association for the Advancement of Science

Awards:

Thornton Peace Prize (1982)
Junior Faculty Research Award (1982)
UNR Foundation Professor (1991)
Conservationist of the Year, Nevada Wildlife Federation (1995)
College of Agriculture Researcher of the Year (1998)
Friend of the Lake Award, League to Save Lake Tahoe (2001)

Other Professional Activities

Environmental Protection Agency: Competitive Grants Review Panel 1985-1995
Environmental Protection Agency: Advisory Committee on Mining Waste 1991-1993
Environmental Protection Agency: Stakeholder Advisory Committee on Commodity Mercury 2007
Nevada Division of Environmental Protection: Technical Advisory Committee on the Carson River Superfund Site 1991-1994
American Chemical Society, Division of Environmental Chemistry: Chair of the Student Awards Committee 1988-1992
American Chemical Society, Division of Environmental Chemistry: Chair of the Awards Committee 1997-2002
UNR Environmental Studies Board: Chairman 1987-1990
Consultant to various public interest organizations, companies and law firms
Hydrology/Hydrogeology Graduate Faculty: Member 1989-present
Reviewer for numerous environmental chemistry journals
Co-owner and vice-president: Nevada Environmental Laboratories (Las Vegas and Reno) 1990-1999
Manager, Environmental Exposure Assessment, Valent USA, Corporation 8/2008- 8/2009

Courses Taught

Humans and the Environment: Environment 100
Environmental Toxicology: NRES 432/632
Environmental Chemicals: Exposure, Transport and Fate: NRES 433/633
Analysis of Environmental Contaminants: NRES 430/630
Risk Assessment, NRES 793C
Global and Regional Issues in Environmental Science: NRES 467/667

Community and Conservation Service Activities

City of Reno, Charter Review Commission: Chairman 1990-93
Peavine Grade School PTA: Co-President 1990-1992
Sierra Club Mining Committee (national): Co-Chair 1989-1992
League to Save Lake Tahoe Board of Directors: 1986-1999
Mountain and Desert Research Fund: 1987-2006
Dupont-Conoco Environmental Leadership Award in Mining Committee: 1989-1994
Nevada Interagency Reclamation Award Committee: 1990-1992
Washoe County School District Science Advisory Board: 1992-2000
Chairman, 1993-94
Earthworks: Board Member 1999-2019
Tahoe Baikal Institute: Board Member 1998-2019, Chair 2002-2003
Environmental Law Alliance Worldwide Board Member: 2000-2020
Great Basin Mine Watch: Board Member 1994-2021, Chair 2001-2006
Center for Science in Public Participation: Board Member 1998-present
Great Basin Institute, Board Member 2000-present, Chair 2001-present
United Nations Environmental Program Committee for Development of a Code for Use of Cyanide in Mining: 2000-2002
Mining, Minerals and Sustainable Development, Assurance Group Committee Member, 2000-2002
National Research Council committee on Methyl Bromide: 1999-2001

National Research Council committee on Mining Technology: 2000-2002
National Research Council committee on USGS Mineral Resources Program, 2000-2003
US Environmental Protection Agency Committee on Management of Mercury Stores in the U.S. 2007
Health Professional Advisory Board, an Advisory Board to the International Joint Commission, 2017-present

Research Interests: Remediation of mine waste contamination. Mining pit lake water quality. Fate and transport of organic compounds in soils and the atmosphere. Methods of remediation of gasoline contaminated soils; Photochemical transformation of organic contaminants on soil surfaces. Instrumental development of chromatographic systems. Development of arid lands biofuels, Effects of methane on drinking water; Photochemical production of perchlorate on sunlight irradiated surfaces, Production of nitrate on thermally treated soils and inorganic surfaces. Hemp chemistry.

Grants Received: (1982-present)

$ 14,550 "Atmospheric Photolysis of Pesticides," A Junior Faculty Research Award from the UNR Research Advisory Board, 1982.

$ 3,000 "Photolysis of CGA-41065," CIBA GEIGY Corporation, 1982.

$ 4,000 "Chemotaxonomy of Sagebrush Using High Performance Liquid Chromatography," Intermountain Research Station USDA, 1984.

$ 83,000 "Analysis of Bovine Tissue for Chlorinated Hydrocarbons," Environmental Protection Agency, 1984-85.

$ 18,300 "Photooxidation of Sulfide Containing Pesticides on Soil Surfaces," Western Regional Pesticide Impact Assessment Program, 1984.

$ 2,500 "Identification of Sagebrush Taxa Based on Liquid Chromatographic Analyses of Phenolics" Research Advisory Board, 1986.

$235,500 "Factors Affecting the Photolysis of Dioxins on Soil Surfaces," U.S. Environmental Protection Agency, 1986-89.

$ 15,160 "Vapor Phase Photolysis of Phorate," American Cyanamid Corporation, 1987.

$ 2,500 "Identification of Sagebrush Taxa Based on Liquid Chromatographic Analyses of Phenolics," UNR Research Advisory Board, 1987.

$ 48,792 "Upgrading Municipal Wastewater Effluents for Urban Water Reuse through Phytochemical Oxidations: System Development and Operational Criteria," U.S. Geological Survey, State Water Research Institute Program (Co-P.I. with Richard Watts), 1986-88.

$ 17,200 "Vapor Phase Photolysis of Malathion," American Cyanamid, 1988.

$ 16,460 "Aging Groundwater: A comparison of the Fluorocarbon Method to the Tritium Method," U.S. Geological Survey, State Water Research Institute Program (Co-P.I. with K. Sertic), 1988-89. (Competitive Grant, State of Nevada) Terminated 6-89.

$206,000 "In Situ Treatment of Organic Hazardous Wastes in Surface Soils Using Fenton's Reagent." U.S. Environmental Protection Agency (Co-P.I. with Richard Watts), 1988-89. (Competitive Grant, national)

$ 23,200 "Evaporation of Gasoline from Soils," Nevada Division of Environmental Protection Co-P.I. with Susan Donaldson), (Contract).

$ 50,000 "Photolysis of Pesticides on Soils," American Cyanamid Corporation (Unrestricted Grant, noncompetitive)

$ 15,600 "Vapor Phase Photolysis of Diazinon and Methyl Parathion" Western Region Pesticide Impact Assessment Program (USDA) (competitive) 1989-90

$ 30,000 "Interface for a Capillary electrophoresis Effluent and a Mass Spectrometer" Linear Corporation 1989-90. (Co P.I. with Murray Hackett) (contract)

$ 15,000 "UV-Gas Chromatographic Dectector" Linear Corporation 1990. (Co P.I. with Murray Hackett) (Noncompetitive grant)

$153,000 "Enhancement of Photodegradation of Pesticides in Soil by Transport Upward in Evaporating Water" (USGS Competitive) 1991-94

$ 50,000 "Pit Water from Precious Metal Mines" U.S. Environmental Protection Agency, 1992-94

$ 91,000 "Remediation of Acid Mine Drainage at Leviathon Mine" Lahontan Water Quality Control Board. (Contract, Co P.I. with Tom Wildman, Colorado School of Mines) 1992-94.

$159,000 " Ecological Toxicology of Metam Sodium and it Derivatives in the Terrestrial and Riparian Environments of the Sacramento River" California Fish and Game, 1992-1995 (G.C. Miller project, part of a larger project with George Taylor at the Desert Research Institute)

$43,092 “Atmospheric Transport and Deposition of Organophosphates and Other Pesticides as Input to Sierra Nevada Surface Waters” USDA-NRI. 1995-98. Co-P.I. with P.I. James N. Seiber. Task 2.

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$50,000 "Release of Gasoline Constituents from Marine Engines to Lake Tahoe" Lahontan Regional Water Quality Control Board, 1998-1999

$70,000 "Impact of Marine Engine Exhaust on Pyramid Lake" U.S. Environmental Protection Agency, in cooperation with the Pyramid Lake Paiute Tribe. 2000-2001.

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$53,000 Passivation of Acid Generating Rock at the Golden Sunlight Mine, Placer Dome Corporation 2002-2003

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$55,000 Passivation of acid Generating rock, Freeport McMoran, 2009-2010

$75,000 Biofuel crops on arid lands, Co-P.I. U.S. Department of Energy, 2010-2011

$104,000 Development of a Good Neighbor Agreement for Mining, P.I. Newmont Mining Corporation 2012-2015

$498,000 Arid lands biofuels and bioproducts. P.I. USDA NIFA, 2013-2017

$75,000 Pesticide Safety Education Program for Nevada, CropLife America (2014-2017)

$38,000, Container composting of biosolids. P.I. Nordic Industries, 2015

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Nevada Division of Environmental Protection
Bureaus of Air Pollution Control & Air Quality Planning
Calendar Year 2020 Actual Production/Emission Reporting Spreadsheet for Mercury Emissions from the Precious Metals Mining Industry

Cumulative Nevada Mercury Control Program (NMCP): Mercury Operating Permit To Construct (MOPTC) Data Submittals

Pollutant ID	Production/Heat Rate	Production Units (eg. tons/yr)	Emissions Factor	Emissions Factor Units	Hg Annual Emissions (lbs/yr)	Hours Operated	Hg Co-Product (tons/yr)	Notes
Source: Nevada Gold Mines LLC - Twin Creeks Mine (formerly Newmont - Twin Creeks Mine): FIN A0003; Class 1 AQOP AP1041-0723.03; MOPTC AP1041-2218								
System Description: Juniper Mill Electric Induction Furnace #1 (S2.008/TU4.001 - 1 of 2, only one operates at a time)								
Hg	413.20	tpy	0.00095	lbs/hr	0.3925	413	0.0000	Induction Furnace #1 emissions factor derived from Sept. 2020 M29 stack test.
System Description: Juniper Mill Electric Induction Furnace #2 (S2.008.1/TU4.002 - 1 of 2, only one operates at a time)								
Hg	Not Reported	tpy	0.00025	lbs/hr	0.1079	432	0.0000	Induction Furnace #2 emissions factor derived from Sept. 2020 M29 stack test.
System Description: Juniper Mill Carbon Kiln (S2.002/TU4.003)								
Hg	4,375.00	tpy	0.00025	lbs/hr	1.6978	6,791	0.0000	Carbon Kiln emissions factor derived from April 2020 M29 stack test.
System Description: Mercury Retort A (Circuit #1: S2.006/TU4.004)								
Hg	66.50	tpy	0.0000048	lbs/hr	0.0219	4,557	0.0000	Retort A emissions factor derived from April 2020 M29 stack test.
System Description: Mercury Retort B (Circuit #2: S2.007/TU4.005)								
Hg	45.30	tpy	0.000024	lbs/hr	0.0846	3,527	0.0000	Retort B emissions factor derived from December 2020 M29 stack test.
System Description: Sage Mill Autoclave #1 (S2.009/TU4.012)								
Hg	2,072,424.60	tpy	0.00036	lbs/hr	2.7093	7,526	0.0000	Autoclave #1 emissions factor derived from October 2020 M29 stack test.
System Description: Sage Mill Autoclave #2 (S2.010/TU4.013)								
Hg	2,050,018.70	tpy	0.00028	lbs/hr	2.0934	7,477	0.0000	Autoclave #2 emissions factor derived from October 2020 M29 stack test.
System Description: Electro-winning Cells (S2.056/TU4.009 - six cells ducted to common stack)								
Hg	79.92	MMgal/yr	0.00032	lbs/hr	2.8109	8,784	0.0000	Electro-winning Cells emissions factor derived from October 2020 M29 stack test.
System Description: Juniper Mill Pregnant & Barren Strip Solution Tanks (S2.053 - S2.055/TU4.006 - TU4.008)								
Hg	79.92	MMgal/yr	0.0016	lbs/hr	14.0544	8,784	0.0000	Preg./Barren Tanks emissions factor derived from October 2020 M29 stack test.
System Description: Pinon Mill Pregnant & Barren Strip Solution Tanks (S2.057 & S2.058/TU4.010 & TU4.011)								
Hg	29.43	MMgal/yr	0.00056	lbs/hr	2.3520	4,200	0.0000	P/B Tanks emissions factor derived from October 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		2.7000	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Laboratory Sample Prep., Fire Assay, Wet Lab, Slurry Prep., LECO, Instrumentation, Met Lab, & Autoclave Rooms (S2.040 - S2.044/DM3.001 - DM3.042)								
Hg					3.9781		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		434.3715		8.9100	CY2006 Co-product: 17,820 lbs/yr
			CY2007 Facility Total:		929.9303		13.2160	CY2007 Co-product: 26,432 lbs/yr.
			CY2008 Facility Total:		1,679.1864		8.8000	CY2008 Co-product: 17,600 lbs/yr.
			CY2009 Facility Total:		425.7559		5.9080	CY2009 Co-product: 11,816 lbs/yr.
			CY2010 Facility Total:		178.8392		5.4670	CY2010 Co-product: 10,934 lbs/yr.
			CY2011 Facility Total:		452.1731		3.9940	CY2011 Co-product: 7,988 lbs/yr.
			CY2012 Facility Total:		695.2002		4.6530	CY2012 Co-product: 9,308 lbs/yr.
			CY2013 Facility Total:		148.5169		7.7370	CY2013 Co-product: 15,474 lbs/yr.
			CY2014 Facility Total:		68.4077		10.0105	CY2014 Co-product: 20,021 lbs/yr.
			CY2015 Facility Total:		20.2603		5.2900	CY2015 Co-product: 10,580 lbs/yr.
			CY2016 Facility Total:		19.9695		10.2200	CY2016 Co-product: 20,439 lbs/yr.
			CY2017 Facility Total:		21.2494		11.0290	CY2017 Co-Product 22,058 lbs/yr.
			CY2018 Facility Total:		65.9254		16.5000	CY2018 Co-Product 33,000 lbs/yr.
			CY2019 Facility Total:		58.5206		11.0010	CY2019 Co-Product 22,002 lbs/yr.
			CY2020 Facility Total:		**30.3028**		**2.7000**	**CY2020 Co-product: 5,400 lbs/yr collected.**

Source: Jerritt Canyon Gold, LLC - Jerritt Canyon Mine: FIN A0004; Class 1 AQOP AP1041-3422; MOPTC AP1041-2217								
System Description: West Roaster Process (S2.031 & S2.033/TU4.002 & TU4.002A - West Roaster & West Quench Tank)								
Hg	Not Reported	tpy	0.00229	lbs/hr	16.4559	7,186	0.0000	Roaster emissions factor derived from June 2020 M29 stack test.
System Description: East Roaster Process (S2.032 & S2.034/TU4.003 & TU4.003A - East Roaster & East Quench Tank)								
Hg	Not Reported	tpy	0.00157	lbs/hr	11.6981	7,451	0.0000	Roaster emissions factor derived from June 2020 M29 stack test.
System Description: Ore Dryer (S2.022/TU4.001)								
Hg	Not Reported	tpy	0.00232	lbs/hr	9.7811	4,216	0.0000	Ore Dryer emissions factor derived from July 2020 M29 stack test.
System Description: Mercury Retort (S2.039.1/TU4.008)								
Hg	Not Reported	tpy	0.000127	lbs/hr	0.3167	2,494	4.6670	Retort emissions factor derived from July 2020 M29 stack test.
System Description: Refining Process Induction Furnace (S2.039.2/TU4.009)								
Hg	Not Reported	tpy	0.000187	lbs/hr	0.0209	112	0.0000	Furnace emissions factor derived from September 2020 M29 stack test.
System Description: Electro-winning Cells & Pregnant/Barren Strip Solution Tanks (S2.038.1 - S2.038.4/TU4.004 - TU4.007)								
Hg	Not Reported	gal/yr	0.001501	lbs/hr	11.0369	7,353	0.0000	EW Cells and P/B Tanks emissions factor derived from July 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Laboratory Units Including Five Large Ore Drying Ovens (S2.042.1 - S2.042.3/DM3.001 - DM3.017)								
Hg					4.2726		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		293.9245		2.9600	CY2006 Co-product: 5,920 lbs/yr.
			CY2007 Facility Total:		1,966.3934		1.0200	CY2007 Co-product: 2,040 lbs/yr.
			CY2008 Facility Total:		219.9723		0.7100	CY2008 Co-product: 1,420 lbs/yr.
			CY2009 Facility Total:		138.9704		2.1000	CY2009 Co-product: 4,200 lbs/yr.
			CY2010 Facility Total:		34.9527		11.0380	CY2010 Co-product: 22,076 lbs/yr.
			CY2011 Facility Total:		69.8714		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		29.8595		1.5200	CY2012 Co-product: 3,040 lbs/yr.
			CY2013 Facility Total:		26.6023		2.5600	CY2013 Co-product: 5,120 lbs/yr.
			CY2014 Facility Total:		13.4934		3.9820	CY2014 Co-product: 7,964 lbs/yr.
			CY2015 Facility Total:		97.0995		5.3400	CY2015 Co-product: 10,675 lbs/yr.
			CY2016 Facility Total:		134.1763		4.4500	CY2016 Co-product: 8,900 lbs/yr.
			CY2017 Facility Total:		148.8118		5.0200	CY2017 Co-product: 10,035 lbs/yr.
			CY2018 Facility Total:		112.3515		10.2800	CY2018 Co-product: 20,557 lbs/yr.
			CY2019 Facility Total:		32.8193		4.7230	CY2019 Co-product: 9,445 lbs/yr.
			CY2020 Facility Total:		**53.5823**		**4.6670**	**CY2020 Co-product: 9,334 lbs/yr.**

Source: Nevada Gold Mines LLC - Carlin Mine (formerly Newmont - Gold Quarry): FIN A0002; Class 1 AQOP AP1041-0793.02; MOPTC AP1041-2219								
System Description: Mill 6 Static Separator Double Rotator Air Pre-Heater (S2.120/TU4.001)								
Hg	3,287,309.00	tpy	0.00207	lbs/hr	15.7030	7,586	0.0000	Static Separator emissions factor derived from September 2020 M29 stack test.
System Description: CFB North and South Ore Preheaters (S2.126 & S2.129/ TU4.002 & TU4.003)								
Hg	3,361,028.00	tpy	0.000555	lbs/hr	4.3326	7,806	0.0000	Ore Preheater's emissions factor derived from September 2020 M29 stack test.
System Description: CFB North and South Ore Roasters (S2.133 & S2.145/TU4.004 & TU4.005)								
Hg	3,361,028.00	tpy	0.0017	lbs/hr	13.2702	7,806	5.5100	Ore Roaster's factor derived from September 2020 M29 stack test.
System Description: ROTP North Calcine Quench Circuit (S2.158 & S2.159/TU4.006 - TU4.009)								
Hg	1,802,402.00	tpy	0.00466	lbs/hr	34.6191	7,429	0.0000	North Quench Circuit emissions factor derived from Sept. 2020 M29 stack test.
System Description: ROTP South Calcine Quench Circuit (S2.160 & S2.161/TU4.010 - TU4.013)								
Hg	1,558,625.00	tpy	0.00419	lbs/hr	31.0060	7,400	0.0000	South Quench Circuit emissions factor derived from Sept. 2020 M29 stack test.
System Description: AARL Carbon Stripping Circuit Pregnant Tanks (S2.228 & S2.229/TU4.014 & TU4.015)								
Hg	45,273,653.00	gal/yr	0.000365	lbs/hr	3.0394	8,327	0.0000	Carbon Strip Circuit EF derived from average of September 2020 M29 stack tests.
System Description: Refinery Barren Tank & Electro-winning Cells (S2.230/TU4.016 & TU4.017)								
Hg	45,273,653.00	gal/yr	0.000736	lbs/hr	5.9344	8,063	0.0000	Barren Tank/EW Cells EF derived from average of Sept. 2020 M29 stack tests.
System Description: Electric Refinery Induction Furnaces (S2.047 - S2.049/TU4.024 - TU4.026)								
Hg	77.90	tpy	0.0321	lbs/hr	15.4080	480	0.0000	Induction Furnaces EF derived from average of September 2020 M29 stack tests.
System Description: Carbon Kiln #1 (Zadra Building) Scrubber Stack (S2.056/TU4.027)								
Hg	8,092.00	tpy	0.00284	lbs/hr	23.0512	8,117	0.2600	Carbon Kiln #1 EF derived from average of September 2020 M29 stack tests.
System Description: Carbon Kiln #2 (AARL Building) Scrubber Stack (S2.058/TU4.028)								
Hg	7,892.00	tpy	0.0034	lbs/hr	27.1388	7,982	0.5800	Carbon Kiln #2 EF derived from average of September 2020 M29 stack tests.
System Description: Refinery Mercury Retort Circuit #1 (S2.225/TU4.029)								
Hg	24.50	tpy	4.96E-08	lbs/hr	0.0001	1,407	1.8200	Retort Circuit #1 emissions factor derived from September 2020 M29 stack test.
System Description: Refinery Mercury Retort Circuit #2 (S2.226/TU4.030)								
Hg	19.90	tpy	6.35E-08	lbs/hr	0.0001	1,159	1.4100	Retort Circuit #2 emissions factor derived from September 2020 M29 stack test.
System Description: Refinery Mercury Retort Circuit #3 (S2.227/TU4.031)								
Hg	14.50	tpy	1.07E-07	lbs/hr	0.0001	1,052	1.4600	Retort Circuit #3 emissions factor derived from September 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility reported by thermal unit, see table.
System Description: Assay Laboratory, Met Laboratory & Integrated Laboratory (S2.230/DM3.001 - DM3.074)								
Hg					0.9080		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		310.6937		2.7200	CY2006 Co-product: 5,440 lbs/yr.
			CY2007 Facility Total:		504.4204		6.1600	CY2007 Co-product: 12,320 lbs/yr.
			CY2008 Facility Total:		422.4137		6.7700	CY2008 Co-product: 13,540 lbs/yr.
			CY2009 Facility Total:		280.6857		5.3900	CY2009 Co-product: 10,780 lbs/yr.
			CY2010 Facility Total:		397.1321		5.7000	CY2010 Co-product: 11,400 lbs/yr.
			CY2011 Facility Total:		222.6075		3.8500	CY2011 Co-product: 7.700 lbs/yr.
			CY2012 Facility Total:		231.8539		7.6100	CY2012 Co-product: 15,220 lbs/yr.
			CY2013 Facility Total:		96.6344		4.3200	CY2013 Co-product: 8,640 lbs/yr.
			CY2014 Facility Total:		115.9110		6.2800	CY2014 Co-product: 12,560 lbs/yr.
			CY2015 Facility Total:		180.7430		5.2700	CY2015 Co-product: 10,540 lbs/yr.
			CY2016 Facility Total:		132.1134		6.2500	CY2016 Co-product: 12,500 lbs/yr.
			CY2017 Facility Total:		193.9456		11.0100	CY2017 Co-product: 22,020 lbs/yr.
			CY2018 Facility Total:		245.1659		9.7685	CY2018 Co-product: 19,540 lbs/yr.
			CY2019 Facility Total:		310.9579		11.1210	CY2019 Co-product: 22,420 lbs/yr.
			CY2020 Facility Total:		**174.4109**		**11.0400**	**CY2020 Co-product: 22,080 lbs/yr.**

Source: Klondex Midas Operations, Inc. - Midas/Ken Snyder Mine: FIN A0175; Class 2 AQOP AP1041-0766.02; OPTC AP1041-2989; MOPTC AP1041-2253								
System Description: Refinery Furnace #1 (S2.044/TU4.001)								
Hg	Not Reported	tpy	0.000072	lbs/hr	0.0013	19	0.0000	Furnace #1 emissions factor derived from September 2019 M29 stack test.
System Description: Refinery Furnace #2 (S2.045/TU4.002)								
Hg	Not Reported	tpy	0.00026	lbs/hr	0.0049	19	0.0000	Furnace #2 emissions factor derived from September 2019 M29 stack test.
System Description: Retort A (S2.047/TU4.003)								
Hg	0.00	tpy	0	lbs/hr	0.0000	0	0.0000	Retort A did not operate in 2020.
System Description: Retort C (S2.052/TU4.005)								
Hg	Not Reported	tpy	0.00000103	lbs/hr	0.0000	27	0.0001	Retort C emissions factor derived from September 2019 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility-wide mercury co-product reported under Retorts A & C.
System Description: Assay Laboratory (S2.044 & S2.045/DM3.001 - DM3.012)								
Hg				lbs/hr	2.3159		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
The Midas refinery was placed on care and maintenance in May, 2020. Therefore, no performance testing was conducted in 2020, stack test results reported are 2019 test results.			CY2006 Facility Total:		17.1801		0.0000	CY2006 Co-product: 0.00 lbs/yr.
			CY2007 Facility Total:		4.2457		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		41.3420		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		6.4395		0.0000	CY2009 Co-product: 0.00 lbs/yr.
			CY2010 Facility Total:		14.2333		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		32.0815		0.0099	CY2011 Co-product: 19.87 lbs/yr.
			CY2012 Facility Total:		21.8322		0.0100	CY2012 Co-product: 10.40 lbs/yr.
			CY2013 Facility Total:		16.3548		0.0059	CY2013 Co-product: 11.90 lbs/yr.
			CY2014 Facility Total:		2.6214		0.0030	CY2014 Co-product: 5.72 lbs/yr.
			CY2015 Facility Total:		3.0071		0.0020	CY2015 Co-product: 3.96 lbs/yr.
			CY2016 Facility Total:		6.5749		0.0020	CY2016 Co-product: 3.24 lbs/yr.
			CY2017 Facility Total:		16.1134		0.0000	CY2017 Co-product: 0.18 lbs/yr.
			CY2018 Facility Total:		2.5650		0.1000	CY2018 Co-product: 20 lbs/yr.
			CY2019 Facility Total:		2.4908		0.0004	CY2019 Co-product: 0.80 lbs/yr.
			CY2020 Facility Total:		**2.3222**		**0.0001**	**CY2020 Co-product: 0.12 lbs/yr. (0.00006 tpy)**

Source: KG Mining (Bald Mountain), Inc - Huntington Valley/Mooney Basin/South Ops.: FIN 0393; Class 2 AQOP AP1041-1362.02; Class 2 AQOP AP1041-3861; MOPTC AP1041-2246								
System Description: Carbon Converter (TU4.007/S2.023)								
Hg	Not Reported	tpy	0.013	lbs/hr	1.6250	125	0.0000	Carbon Converter emissions factor supplied by source with no back-up.
System Description: Assay Laboratory (DM3.001 - DM3.018)								
Hg					3.5985		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Review.
			CY2006 Facility Total:		204.3025		2.9400	CY2006 Co-product: 5,880 lbs/yr.
			CY2007 Facility Total:		57.4138		2.2750	CY2007 Co-product: 4,550 lbs/yr.
			CY2008 Facility Total:		278.3220		2.6000	CY2008 Co-product: 5,200 lbs/yr.
			CY2009 Facility Total:		5.8995		1.5600	CY2009 Co-product: 3,120 lbs/yr.
			CY2010 Facility Total:		7.8188		1.4300	CY2010 Co-product: 2,860 lbs/yr.
			CY2011 Facility Total:		3.2198		1.6100	CY2011 Co-product: 3,220 lbs/yr.
			CY2012 Facility Total:		3.1464		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		3.6439		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		3.6439		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		3.1239		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		3.1239		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		2.3239		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		2.3239		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		2.3239		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**5.2235**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**

Source: Rawhide Mining, LLC - Denton-Rawhide Mine (formerly Kennecott Rawhide Mining Company): FIN 0406; Class 1 AQOP AP1041-2892; OPTC AP1041-2975; MOPTC AP1041-2245								
System Description: Carbon Regeneration Kiln (S2.001)								
Hg	Not Reported	tpy	0.00053	lbs/hr	4.0943	7,725	0.0000	Carbon Kiln emissions factor derived from December 2020 M29 stack test.
System Description: Electro-winning Circuit (IA3.007)								
Hg	Not Reported	gal/yr	0.000184	lbs/hr	0.6526	3,547	0.0000	Electro-winning Cells emissions factor derived from December 2020 M29 stack test.
System Description: Refinery Induction Furnace (S2.004)								
Hg	Not Reported	tpy	0.000218	lbs/hr	0.2171	996	0.0000	Refinery Furnace emissions factor derived from December 2020 M29 stack test.
System Description: Mercury Retort (S2.002)								
Hg	Not Reported	tpy	0.0000032	lbs/hr	0.0222	6,941	0.0000	Retort emissions factor derived from December 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		0.1896	Facility-wide mercury co-product collected, 99% retort derived.
System Description: Fire Assay Laboratory (DM3.001 - DM3.008)								
Hg					0.0143		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		351.5928		0.0621	CY2006 Co-product: 124.20 lbs/yr.
			CY2007 Facility Total:		39.5645		0.0276	CY2007 Co-product: 55.20 lbs/yr.
			CY2008 Facility Total:		13.0908		0.0262	CY2008 Co-product: 52.40 lbs/yr.
			CY2009 Facility Total:		12.0029		0.0258	CY2009 Co-product: 51.60 lbs/yr.
			CY2010 Facility Total:		37.6433		0.0079	CY2010 Co-product: 15.80 lbs/yr.
			CY2011 Facility Total:		78.5131		0.0230	CY2011 Co-product: 46.00 lbs/yr.
			CY2012 Facility Total:		7.1176		0.0249	CY2012 Co-product: 49.80 lbs/yr.
			CY2013 Facility Total:		0.0743		0.1270	CY2013 Co-product: 254 lbs/yr.
			CY2014 Facility Total:		0.1924		0.0193	CY2014 Co-product: 38.60 lbs/yr.
			CY2015 Facility Total:		0.3959		0.0102	CY2015 Co-product: 20.40 lbs/yr.
			CY2016 Facility Total:		0.5412		0.0005	CY2016 Co-product: 1.04 lbs/yr.
			CY2017 Facility Total:		0.3312		0.0006	CY2017 Co-product: 1.20 lbs/yr.
			CY2018 Facility Total:		0.2867		0.0013	CY2018 Co-product: 2.60 lbs/yr.
			CY2019 Facility Total:		3.2050		0.0208	CY2019 Co-product: 41.5 lbs/yr.
			CY2020 Facility Total:		**5.0005**		**0.1896**	**CY2020 Co-product: 379.2 lbs/yr.**

Source: Hycroft Resources & Development, Inc. - Crofoot/Lewis Mine: FIN 0390; Class 2 AQOP AP1041-0334.02; OPTC AP1041-2974; OPTC AP1041-3269; OPTC AP1041-3344; MOPTC AP1041-2255								
System Description: Mercury Retort #1 (TU4.001)								
Hg	Not Reported	tpy	0.00000746	lbs/hr	0.0275	3,683	0.0000	Retort emissions factor derived from June 2020 M29 stack test.
System Description: Smelting Furnace #1 (TU4.002)								
Hg	Not Reported	tpy	0.0000285	lbs/hr	0.0886	3,109	0.0000	Furnace emissions factor derived from June 2020 M29 stack test.
System Description: Mercury Retort #2 (TU4.003)								
Hg	Not Reported	tpy	0.0000166	lbs/hr	0.0564	3,396	0.0000	Retort emissions factor derived from June 2020 M29 stack test.
System Description: Mercury Retort #3 (TU4.004)								
Hg		tpy		lbs/hr	0.0000		0.0000	System not yet constructed.
System Description: Mercury Retort #4 (TU4.005)								
Hg		tpy		lbs/hr	0.0000		0.0000	System not yet constructed.
System Description: Mercury Retort #5 (TU4.006)								
Hg		tpy		lbs/hr	0.0000		0.0000	System not yet constructed.
System Description: Smelting Furnace #2 (TU4.007)								
Hg		tpy		lbs/hr	0.0000		0.0000	System not yet constructed.
System Description: Smelting Furnace #3 (TU4.008)								
Hg		tpy		lbs/hr	0.0000		0.0000	System not yet constructed.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Assay Laboratory (DM3.001 - DM3.057)								
Hg					4.4797		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		0.0000		0.0000	CY2006 Co-product: 0.00 lbs/yr.
			CY2007 Facility Total:		0.0000		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		0.0000		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		4.5299		0.8000	CY2009 Co-product: 1,600 lbs/yr.
			CY2010 Facility Total:		4.5219		4.2000	CY2010 Co-product: 8,400 lbs/yr.
			CY2011 Facility Total:		4.5242		23.0700	CY2011 Co-product: 46,147 lbs/yr.
			CY2012 Facility Total:		4.4784		34.0200	CY2012 Co-product: 68,047 lbs/yr.
			CY2013 Facility Total:		4.4959		27.6700	CY2013 Co-product: 53,340 lbs/yr.
			CY2014 Facility Total:		5.8421		56.9100	CY2014 Co-product: 113,820 lbs/yr.
			CY2015 Facility Total:		5.6891		35.7000	CY2015 Co-product: 71,400 lbs/yr.
			CY2016 Facility Total:		6.6141		7.3750	CY2016 Co-product: 14,750 lbs/yr.
			CY2017 Facility Total:		4.7013		0.7500	CY2017 Co-product: 1,500 lbs/yr.
			CY2018 Facility Total:		4.4797		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		9.6269		0.0000	CY2019 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2019.
			CY2020 Facility Total:		**4.6522**		**0.0000**	**CY2020 Co-product: 0 lbs/yr.**

Source: Klondex Aurora Mine, Inc.: FIN 0408; Class 2 AQOP AP1041-3858; OPTC AP1041-2853; MOPTC AP1041-2248								
System Description: Carbon Regeneration Kiln, Solution Tanks & Electro-winning Circuit (S2.002 - S2.005/TU4.001 - TU4.003 & TU4.006)								
Hg	DNO	tpy	0	lbs/hr	0.0000	0	0.0000	Carbon Kiln comb. circuit did not operate in 2020.
System Description: Mercury Retorts, Solution Tanks & Electro-winning Circuit (S2.002 - S2.004, S2.006 & S2.007/TU4.002 - TU4.006)								
Hg	Not Reported	tpy	0.000029	lbs/hr	0.0153	529	0.0000	Retorts combined circuit emissions factor derived from October 2019 M29 stack test.
System Description: Dore Furnace, Solution Tanks & Electro-winning Circuit (S2.002 - S2.004 & S2.008/TU4.002, TU4.003, TU4.006 & TU4.007)								
HG	DNO	tpy	0	lbs/hr	0.0000	0	0.0000	Furnace combined circuit did not operate in 2020.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Assay Laboratory (S2.002 - S2.004 & S2.008/DM3.002 - DM3.011)								
Hg					0.0076		0.0000	Potential to emit (PTE) of 0.0076 lbs/yr, not actual - see DM Technical Review.
			CY2006 Facility Total:		0.0000		0.0000	CY2006 Co-product: 0.00 lbs/yr.
			CY2007 Facility Total:		0.0000		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		0.2838		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		0.2838		0.0000	CY2009 Co-product: 0.00 lbs/yr.
			CY2010 Facility Total:		0.0222		0.0000	CY2010 Co-product: 0.00 lbs/yr.
The Esmeralda Project refinery was placed on care and maintenance in early 2020. Therefore, no performance testing was conducted in 2020, stack test results reported are 2019 test results.			CY2011 Facility Total:		0.0022		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		3.7066		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		0.0276		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		0.0076		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		0.0000		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		0.0076		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		0.0223		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.0458		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.2876		0.0000	CY2019 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2019.
			CY2020 Facility Total:		**0.0229**		**0.0000**	**CY2020 Co-product: X.XX lbs/yr.**

Source: Coeur D'Alene Mining Corporation - Coeur Rochester Mine: FIN 0412; Class 2 AQOP AP1044-0063.04; MOPTC AP1044-2242								
System Description: Refinery Furnace (S2.003/TU4.001)								
Hg	Not Reported	tpy	0.00107	lbs/hr	0.8817	824	0.0000	Refinery Furnace emissions factor derived from February 2020 M29 stack test.
System Description: Mercury Retorts (S2.004 & S2.005/TU4.002 & TU4.003)								
Hg	Not Reported	tpy	0.0000144	lbs/hr	0.1532	10,640	0.0000	Retort emissions factor derived from February 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		6.1275	Facility-wide mercury co-product collected, all from retort operations.
System Description: Assay Laboratory (S2.016 - S2.019/DM3.001 - DM3.019)								
Hg					1.8805		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		2.8872		16.1000	CY2006 Co-product: 32,200 lbs/yr.
			CY2007 Facility Total:		137.0958		15.4000	CY2007 Co-product: 30,800 lbs/yr.
			CY2008 Facility Total:		9.9144		15.6000	CY2008 Co-product: 31,200 lbs/yr.
			CY2009 Facility Total:		4.4097		10.7000	CY2009 Co-product: 21,400 lbs/yr.
			CY2010 Facility Total:		2.6426		12.3000	CY2010 Co-product: 24,600 lbs/yr.
			CY2011 Facility Total:		3.3523		11.2000	CY2011 Co-product: 22,400 lbs/yr.
			CY2012 Facility Total:		3.2552		20.4000	CY2012 Co-product: 40,800 lbs/yr.
			CY2013 Facility Total:		2.6378		14.5000	CY2013 Co-product: 29,000 lbs/yr.
			CY2014 Facility Total:		2.1938		13.2000	CY2014 Co-product: 26,400 lbs/yr.
			CY2015 Facility Total:		4.2967		10.4000	CY2015 Co-product: 20,800 lbs/yr.
			CY2016 Facility Total:		3.2330		7.9000	CY2016 Co-product: 15,800 lbs/yr.
			CY2017 Facility Total:		2.3819		9.7000	CY2017 Co-product: 19,480 lbs/yr.
			CY2018 Facility Total:		2.7256		11.8000	CY2018 Co-product: 23,600 lbs/yr.
			CY2018 Facility Total:		3.2955		9.1690	CY2019 Co-product: 18,338 lbs/yr.
			CY2020 Facility Total:		**2.9154**		**6.1275**	**CY2020 Co-product: 12,255 lbs/yr.**

Source: Newmont Mining Corporation - Lone Tree Mine: FIN 0385; Class 2 AQOP AP1041-3575; MOPTC AP1041-2251								
System Description: Sample Room, Fire Assay Room, Wet Laboratory, LECO Laboratory, Met Laboratory (S2.014 - S2.019/DM3.001 - DM3.034)								
Hg					2.1131		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
				CY2006 Facility Total:	622.1013		0.0000	CY2006 Co-product: 0.00 lbs/yr.
				CY2007 Facility Total:	148.0964		0.0000	CY2007 Co-product: 0.00 lbs/yr.
				CY2008 Facility Total:	67.1251		0.0000	CY2008 Co-product: 0.00 lbs/yr.
				CY2009 Facility Total:	7.2136		0.0000	CY2009 Co-product: 0.00 lbs/yr.
				CY2010 Facility Total:	3.0212		0.0000	CY2010 Co-product: 0.00 lbs/yr.
				CY2011 Facility Total:	1.8788		0.0000	CY2011 Co-product: 0.00 lbs/yr.
				CY2012 Facility Total:	1.8788		0.0000	CY2012 Co-product: 0.00 lbs/yr.
				CY2013 Facility Total:	1.8788		0.0000	CY2013 Co-product: 0.00 lbs/yr.
				CY2014 Facility Total:	1.8788		0.0000	CY2014 Co-product: 0.00 lbs/yr.
				CY2015 Facility Total:	1.8788		0.0000	CY2015 Co-product: 0.00 lbs/yr.
				CY2016 Facility Total:	1.8788		0.0000	CY2016 Co-product: 0.00 lbs/yr.
				CY2017 Facility Total:	1.8788		0.0000	CY2017 Co-product: 0.00 lbs/yr.
				CY2018 Facility Total:	1.6849		0.0000	CY2018 Co-product: 0.00 lbs/yr.
				CY2019 Facility Total:	1.6849		0.0000	CY2019 Co-product: 0.00 lbs/yr.
				CY2020 Facility Total:	**2.1131**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**

Source: Barrick Cortez, Inc. - Cortez Hills and Pipeline Projects: FIN 0001; Class 1 AQOP AP1041-2141; MOPTC AP1041-2220								
System Description: Refinery Induction Furnace #1 (S2.002/TU4.003)								
Hg	Not Reported	tpy	0.000028	lbs/hr	0.0055	198	0.0000	Furn. #1 ducted in-line with Retorts, EF derived from August 2020 M29 stack test.
System Description: Refinery Induction Furnace #2 (S2.003/TU4.004)								
Hg	Not Reported	tpy	0.000035	lbs/hr	0.0017	49	0.0000	Furn. #2 ducted in-line with Retorts, EF derived from August 2020 M29 stack test.
System Description: Electric Carbon Reactivation Kiln #1 (S2.007/TU4.005)								
Hg	405.00	tpy	0.00029	lbs/hr	0.2401	828	0.0000	Carbon Kiln #1 emissions factor derived from August 2020 M29 stack test.
System Description: Electric Carbon Reactivation Kiln #2 (S2.008/TU4.006)								
Hg	479.00	tpy	0.00011	lbs/hr	0.1069	972	0.0000	Carbon Kiln #2 emissions factor derived from August 2020 M29 stack test.
System Description: East Electro-winning Circuit including Pregnant and Barren Strip Solution Tanks (S2.060, S2.062 & S2.063/TU4.001, TU4.008 & TU4.009)								
Hg	29,719.00	1000gal/yr	0.000054	lbs/hr	0.4100	7,593	0.0000	East EW Circuit emissions factor derived from August 2020 M29 stack test.
System Description: West Electro-winning Circuit including Pregnant and Barren Strip Solution Tanks (S2.061, S2.062 & S2.063/TU4.002, TU4.008 & TU4.009)								
Hg	27,895.44	1000gal/yr	0.002	lbs/hr	14.7553	7,378	0.0000	West EW Circuit emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort A (S2.004/TU4.010)								
Hg	14.78	tpy	0.000052	lbs/hr	0.0728	1,400	0.0000	Retort A emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort B (S2.005/TU4.011)								
Hg	7.50	tpy	0.000045	lbs/hr	0.0423	940	0.0000	Retort B emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort C (S2.006/TU4.012)								
Hg	0.00	tpy	0	lbs/hr	0.0000	0	0.0000	Retort C did not operate in 2020, not yet constructed.
System Description: Mercury Co-Product								
Hg					0.0000		0.2700	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Assay Laboratory, Met Laboratory, Strip Circuit Area (Mill Building), Refinery Gold Sludge Drying Oven, Fire Assay Fusion Furnaces (S2.018a-g/DM3.001 - DM3.020)								
Hg					1.8841		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		166.7059		0.1200	CY2006 Co-product: 240 lbs/yr.
			CY2007 Facility Total:		208.0466		0.3200	CY2007 Co-product: 640 lbs/yr.
			CY2008 Facility Total:		75.8638		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		1.3905		0.0170	CY2009 Co-product: 34 lbs/yr.
			CY2010 Facility Total:		5.1862		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		5.1815		0.7200	CY2011 Co-product: 1,441 lbs/yr.
			CY2012 Facility Total:		4.2156		1.2100	CY2012 Co-product: 2,412 lbs/yr.
			CY2013 Facility Total:		15.7637		2.2740	CY2013 Co-product: 4,458 lbs/yr.
			CY2014 Facility Total:		2.2159		0.4900	CY2014 Co-product: 980 lbs/yr.
			CY2015 Facility Total:		4.6010		1.1700	CY2015 Co-product: 2,340 lbs/yr.
			CY2016 Facility Total:		6.0125		0.2600	CY2016 Co-product: 524 lbs/yr.
			CY2017 Facility Total:		3.8086		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		3.3285		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		19.9164		0.2850	CY2019 Co-product: 570 lbs/yr.
			CY2020 Facility Total:		**17.5188**		**0.2700**	**CY2020 Co-product: 536 lbs/yr.**

Source: Florida Canyon Mining, Inc. - Florida Canyon Mine: FIN 0386; Class 2 AQOP AP1041-0106.03; MOPTC AP1041-2256								
System Description: Summit Valley Mercury Retort A (S2.005/TU4.004)								
Hg	Not Reported	tpy	0.00005758	lbs/hr	0.0273	475	0.0000	Retort A EF derived from average of October and December 2020 M29 stack tests.
System Description: Custom Mercury Retort B (S2.006/TU4.005)								
Hg	Not Reported	tpy	2.0314E-05	lbs/hr	0.0121	595	0.0000	Retort B emissions factor derived from August 2019 M29 stack tests.
System Description: Electro-winning Cell A (IA1.039/TU4.002)								
Hg	Not Reported	tpy	0.0004485	lbs/hr	3.7889	8,448	0.0000	EW Cell A EF derived from avg. of October and December 2020 M29 stack tests.
System Description: Electro-winning Cell B (IA1.039/TU4.003)								
Hg	Not Reported	tpy	0.0001547	lbs/hr	1.3069	8,448	0.0000	EW Cell B EF derived from avg. of October and December 2020 M29 stack tests.
System Description: Carbon Regeneration Kiln (S2.004/TU4.008)								
Hg	Not Reported	tpy	0.00146445	lbs/hr	1.8839	1,286	0.0000	C Kiln EF derived from average of October and December 2019 M29 stack tests.
System Description: Dore Furnace (S2.003/TU4.001)								
Hg	Not Reported	tpy	0.0266385	lbs/hr	6.3266	238	0.0000	Furnace EF derived from average of October and December 2020 M29 stack tests.
System Description: Pregnant Tank (IA1.039/TU4.006)								
Hg	Not Reported	hrs/yr		lbs/hr	0.0000	8,448	0.0000	Pregnant Tank moved to permit 01/22/2020, no testing conducted in 2020.
System Description: Barren Tank (IA1.039/TU4.007)								
Hg	Not Reported	hrs/yr		lbs/hr	0.0000	8,448	0.0000	Barren Tank moved to permit 01/22/2020, no testing conducted in 2020.
System Description: Mercury Co-Product								
Hg					0.0000		0.1660	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Assay Laboratory, Electro-winning Cells A & B, Pregnant & Barren Tanks and Dore Furnace (S2.004/DM3.001 - DM3.020)								
Hg					2.9861		0.0000	Calculated PTE = 2.9861 lbs/yr. EW Cells and Dore Furnace reported separately.
			CY2006 Facility Total:		440.7382		0.2264	CY2006 Co-product: 452.80 lbs/yr.
			CY2007 Facility Total:		19.0000		0.0072	CY2007 Co-product: 14.40 lbs/yr.
			CY2008 Facility Total:		162.3117		0.2875	CY2008 Co-product: 575 lbs/yr.
			CY2009 Facility Total:		49.6118		0.8120	CY2009 Co-product: 1,624 lbs/yr.
			CY2010 Facility Total:		111.8133		0.3090	CY2010 Co-product: 618 lbs/yr.
			CY2011 Facility Total:		51.7290		1.2700	CY2011 Co-product: 2,538 lbs/yr. (1,829.00 "liquid"; 709.00 sludge)
			CY2012 Facility Total:		8.2449		0.6300	CY2012 Co-product: 1,252 lbs/yr. (892.00 "liquid"; 360.00 sludge)
			CY2013 Facility Total:		4.2320		1.2150	CY2013 Co-product: 1,450 lbs/yr. (sludge)
			CY2014 Facility Total:		4.1346		0.1250	CY2014 Co-product: 250 lbs/yr. (sludge)
			CY2015 Facility Total:		33.4578		0.8960	CY2015 Co-product: 1,792 lbs/yr. (sludge)
			CY2016 Facility Total:		55.9107		0.1200	CY2016 Co-product: 244 lbs/yr. (sludge)
			CY2017 Facility Total:		3.7025		0.1800	CY2017 Co-product: 352 lbs/yr. (sludge)
			CY2018 Facility Total:		3.8420		0.0800	CY2018 Co-product: 162 lbs/yr. (sludge)
			CY2019 Facility Total:		10.1405		0.0000	CY2019 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2019.
			CY2020 Facility Total:		**16.3319**		**0.1660**	**CY2020 Co-product: 332 lbs/yr. (sludge)**

Source: Round Mountain Gold Corporation - Smoky Valley/Gold Hill Common Operation: FIN 0394; Class 2 AQOP AP1041-0444.02; OPTC AP1041-2806: MOPTC AP1041-2250								
System Description: Round Mountain (Smoky Valley) Carbon Reactivation Kiln (S2.015/TU4.001)								
Hg	Not Reported	tpy	0.000043	lbs/hr	0.3076	7,154	0.0000	Carbon Kiln emissions factor derived from May 2020 M29 stack test.
System Description: Round Mountain (Smoky Valley) Electric Induction Furnace (S2.014/TU4.005)								
Hg	Not Reported	tpy	0.000015	lbs/hr	0.0066	437	0.0000	Furnace emissions factor derived from May 2020 M29 stack test.
System Description: Gold Hill Carbon Reactivation Kiln (S2.053/TU4.006)								
Hg	Not Reported	tpy	0.000024	lbs/hr	0.0986	4,108	0.0000	Carbon Kiln emissions factor derived from May 2020 M29 stack test.
System Description: Gold Hill Carbon Stripping Circuit - Electro-winning Circuit & Pregnant/Barren Strip Solution Tanks (S2.054 - S2.056/TU4.007 - TU4.009)								
Hg	Not Reported	gals/yr	0.000006	lbs/hr	0.0508	8,465	0.0000	Carbon Strip Circuit emissions factor derived from May 2020 M29 stack test.
System Description: Gold Hill Mercury Retort (S2.057/TU4.010)								
Hg	18.11	tpy	7.5E-08	lbs/hr	0.0003	3,727	0.0000	Retort emissions factor derived from May 2020 M29 stack test.
System Description: Gold Hill Smelting Furnace (S2.162/TU4.011)								
Hg	Not Reported	tpy	0.0015	lbs/hr	0.4890	326	0.0000	Furnace emissions factor derived from May 2020 M29 stack test.
System Description: Smoky Valley ADR Carbon Stripping Circuit - Electro-winning Circuit, Pregnant (1) & Barren (2) Strip Solution Tanks (S2.016 - S2.018 & S2.052/TU4.002 - TU4.004 & TU4.012)								
Hg	Not Reported	gals/yr	0.0001	lbs/hr	0.8405	8,405	0.0000	Carbon Strip Circuit emissions factor derived from May 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		2.3581	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: RMG Refinery Electro-winning Vent & Ovens, Assay Laboratory Ovens (S2.143/DM3.001 - DM3.042)								
Hg					1.7440		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		0.0000		0.0085	CY2006 Co-product: 17 lbs/yr.
			CY2007 Facility Total:		59.6652		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		8.3173		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		4.5878		0.0000	CY2009 Co-product: 0.00 lbs/yr.
			CY2010 Facility Total:		4.4525		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		6.6374		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		4.1960		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		4.7056		0.3150	CY2013 Co-product: 629.90 lbs/yr.
			CY2014 Facility Total:		9.0652		0.3450	CY2014 Co-product: 690 lbs/yr.
			CY2015 Facility Total:		5.4557		0.2940	CY2015 Co-product: 588 lbs/yr.
			CY2016 Facility Total:		6.8767		0.6860	CY2016 Co-product: 1,372 lbs/yr.
			CY2017 Facility Total:		5.8494		0.3900	CY2017 Co-product: 780 lbs/yr.
			CY2018 Facility Total:		8.7114		2.1050	CY2018 Co-product: 4,210 lbs/yr.
			CY2019 Facility Total:		19.6374		1.7571	CY2019 Co-product: 3,515 lbs/yr.
			CY2020 Facility Total:		**3.5373**		**2.3581**	**CY2020 Co-product: 4,716.20 lbs/yr.**

Source: Ruby Hill Mining Company, LLC - Ruby Hill Mine (formerly Homestake Mining Company of California): FIN 0399; Class 2 AQOP AP1041-0713.01; MOPTC AP1041-2252								
System Description: Assay Laboratory (DM3.001 - DM3.010)								
Hg					0.0000		0.0000	Potential to emit (PTE) of 1.3818 lbs/yr, not actual - see De Minimis Tech. Review
				CY2006 Facility Total:	28.7825		0.5000	CY2006 Co-product: 1,000 lbs/yr.
				CY2007 Facility Total:	35.2201		0.3800	CY2007 Co-product: 760 lbs/yr.
				CY2008 Facility Total:	1.3883		0.2400	CY2008 Co-product: 480 lbs/yr.
				CY2009 Facility Total:	7.2874		0.1762	CY2009 Co-product: 352.40 lbs/yr.
				CY2010 Facility Total:	34.4158		0.0000	CY2010 Co-product: 0.00 lbs/yr.
				CY2011 Facility Total:	11.1401		0.0495	CY2011 Co-product: 99 lbs/yr.
				CY2012 Facility Total:	1.3818		0.0000	CY2012 Co-product: 0.00 lbs/yr.
				CY2013 Facility Total:	1.3818		0.0000	CY2013 Co-product: 0.00 lbs/yr.
				CY2014 Facility Total:	1.3818		0.0000	CY2014 Co-product: 0.00 lbs/yr.
				CY2015 Facility Total:	1.3818		0.0000	CY2015 Co-product: 0.00 lbs/yr.
				CY2016 Facility Total:	1.3818		0.0000	CY2016 Co-product: 0.00 lbs/yr.
				CY2017 Facility Total:	1.3818		0.0000	CY2017 Co-product: 0.00 lbs/yr.
				CY2018 Facility Total:	1.3818		0.0000	CY2018 Co-product: 0.00 lbs/yr.
				CY2019 Facility Total:	1.3818		0.0000	CY2019 Co-product: 0.00 lbs/yr.
				CY2020 Facility Total:	**0.0000**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr. Source did not operate in 2020.**

Source: Marigold Mining Company - Marigold Mine: FIN 0387; Class 2 AQOP AP1041-3666; MOPTC AP1041-2254								
System Description: Carbon Regeneration Kiln (TU4.001/S2.006)								
Hg	953.83	tpy	0.0000037	lbs/hr	0.0138	3,741	0.0000	Carbon Kiln emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort (TU4.002/S2.007A)								
Hg	10.30	tpy	0.0000059	lbs/hr	0.0089	1,516	0.0000	Retort emissions factor derived from average of August 2020 M29 stack tests.
System Description: Tilting Crucible Furnace (TU4.003/S2.007B)								
Hg	2.41	tpy	0.000084	lbs/hr	0.0272	324	0.0000	Furnace emissions factor derived from average of August 2020 M29 stack tests.
System Description: Electro-winning Circuit (TU4.004/S2.007C)								Electro-winning Circuit emissions factor derived from August 2020 M29 stack test of all passive units (fluids systems). The Pregnant and Barren Strip Solution Tanks are vented to a common stack with the Electro-winning Circuit, Mercury Retort and Crucible Furnace. Normally the Retort result is used as a surrogate, but for 2020 the passive units were tested separately and have their own result.
Hg	21,721.90	1000gal/yr	0.0000073	lbs/hr				
System Description: Pregnant Strip Solution Tank (TU4.005/S2.007D)								
Hg	21,721.90	1000gal/yr		lbs/hr				
System Description: Barren Strip Solution Tank (TU4.006/S2.007E)								
Hg	21,721.90	1000gal/yr		lbs/hr	0.0491	6,728	0.0000	
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Elemental mercury collected disposed of as hazardous waste, not co-product.
System Description: Assay Laboratory (DM3.001 - DM3.021)								
Hg					2.1072		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		908.0610		0.1675	CY2006 Co-product: 335 lbs/yr.
			CY2007 Facility Total:		5.2255		0.2450	CY2007 Co-product: 490 lbs/yr.
			CY2008 Facility Total:		10.4883		0.5690	CY2008 Co-product: 1,138 lbs/yr.
			CY2009 Facility Total:		4.4540		0.8160	CY2009 Co-product: 1,632 lbs/yr.
			CY2010 Facility Total:		9.3695		1.0330	CY2010 Co-product: 2,066 lbs/yr.
			CY2011 Facility Total:		11.1707		1.0500	CY2011 Co-product: 2,100 lbs/yr.
			CY2012 Facility Total:		2.1159		1.4600	CY2012 Co-product: 2,927 lbs/yr.
			CY2013 Facility Total:		7.5577		0.4765	CY2013 Co-product: 953 lbs/yr.
			CY2014 Facility Total:		3.3689		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		24.8525		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		29.7823		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		45.7881		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		2.3697		0.4900	CY2018 Co-product: 979 lbs/yr.
			CY2019 Facility Total:		2.1723		0.0000	CY2019 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2019.
			CY2020 Facility Total:		**2.2063**		**0.0000**	**CY2020 Co-product: X.XX lbs/yr.**

Source: Borealis Mining Company: FIN 0675; Class 1 AQOP AP1041-2855; MOPTC AP1041-2228								
System Description: Deep Bed Carbon Scrubber: Carbon Regeneration Kiln (S2.003/TU4.001)								
Hg	91.51	tpy	0.00000722	lb/hr	0.0091	1,265	0.0000	Carbon Kiln emissions factor derived from August 2020 M29 stack tests.
System Description: Deep Bed Carbon Scrubber: Mercury Retort (S2.004/TU4.002)								
Hg	0.94	tpy	0.00000634	lb/hr	0.0014	222	0.0000	Retort emissions factor derived from June 2019 M29 stack test.
System Description: Deep Bed Carbon Scrubber: Smelting Furnace (2.005/TU4.003)								
Hg	Not Reported	tpy	0.00000728	lb/hr	0.0006	87	0.0000	Furnace emissions factor derived from average of August 2020 M29 stack tests.
System Description: Deep Bed Carbon Scrubber: Solutions Circuit (S2.006 - S2.008/TU4.004 - TU4.006)								
Hg	Not Reported	1000gal/yr	0.00000665	lb/hr	0.0133	2,005	0.0000	Solutions Circuit emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	No facility-wide mercury co-product collected, no breakout by system provided.
			CY2006 Facility Total:		0.0000		0.0000	CY2006 Co-product: 0.00 lbs/yr.
			CY2007 Facility Total:		0.0000		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		0.0000		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		0.0000		0.0000	CY2009 Co-product: 0.00 lbs/yr.
			CY2010 Facility Total:		0.0000		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		0.0000		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		12.0456		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		0.0353		0.1640	CY2013 Co-product: 327.50 lbs/yr.
			CY2014 Facility Total:		0.0372		0.3510	CY2014 Co-product: 702 lbs/yr.
			CY2015 Facility Total:		9.4184		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		0.0201		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		0.0022		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.0073		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.1263		0.0000	CY2019 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2019.
			CY2020 Facility Total:		**0.0245**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2020.**

Source: Nevada Gold Mines LLC (formerly Barrick Turquoise Ridge) Turquoise Ridge/Getchell Mine: FIN 0389; Class 2 AQOP AP1041-0292.01; MOPTC AP1041-2249								
System Description: Assay/Met Laboratory (S2.001.1 - S2.001.4/DM3.001 - DM3.016)								
Hg		tpy		lb/hr	0.3359		0.0000	0.3345 lbs/yr potential to emit (PTE) - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		10.6752		0.0000	CY2006 Co-product: 0.00 lbs/yr.
			CY2007 Facility Total:		4.9660		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		4.9462		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		4.9462		0.0000	CY2009 Co-product: 0.00 lbs/yr.
			CY2010 Facility Total:		4.9462		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		4.9462		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		4.9462		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		4.9462		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		4.7375		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		4.6574		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		4.6574		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		6.2634		0.0000	CY2017 Co-product: 0.00 lbs/yr. Stack testing revealed exceedance of DM cap.
			CY2018 Facility Total:		0.3345		0.0000	CY2018 Co-product: 0.00 lbs/yr. Source revised DM Desig. after 2017 testing.
			CY2019 Facility Total:		0.3345		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**0.3359**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**

Source: GRP Pan, LLC (formerly Midway Gold US, Inc.): FIN 1497; Class 1 AQOP AP1041-3674; Class 2 AQOP AP1041-3831; MOPTC AP1041-3302								
System Description: Carbon Kiln (S2.006/TU4.001)								
Hg	Not Reported	tpy	0.00081	lbs/hr	5.1234	6,325	0.0000	Carbon Kiln EF derived from avg. of 11/2020 & 2/2021 M29 stack tests.
System Description: Mercury Retort (S2.008/TU4.002)								
Hg	3.08	tpy	0.0000036	lbs/hr	0.0030	834	0.0000	Retort emissions factor derived from November 2020 M29 stack test.
System Description: Melt Furnace (S2.010/TU4.003)								
Hg	Not Reported	tpy	0.00033	lbs/hr	0.1008	306	0.0000	Furnace EF derived from avg. of 11/2020 & 2/2021 M29 stack tests.
System Description: Carbon Stripping/Electro-winning Cells & Barren Tanks (S2.011/TU4.004 - TU4.006)								
Hg	Not Reported	tpy	0.00075	lbs/hr	4.1940	5,592	0.0000	Carbon Stripping Circuit EF derived from avg. of 11/2020 & 2/2021 M29 stack tests.
System Description: Mercury Co-Product								
Hg					0.0000		0.5480	Facility-wide mercury co-product collected, no breakout by system provided.
System Description: Assay Laboratory (S2.011/DM3.001 - DM3.008)								
Hg					2.4700		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2013 Facility Total:		0.0000		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		0.0000		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		2.5131		0.3200	CY2015 Co-product: 637.32 lbs/yr.
			CY2016 Facility Total:		2.4911		0.4900	CY2016 Co-product: 970.07 lbs/yr.
			CY2017 Facility Total:		61.3590		0.4300	CY2017 Co-product: 869.90 lbs/yr.
			CY2018 Facility Total:		10.9418		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		2.8751		0.0000	CY2019 Co-product: 0.00 lbs/yr. No Hg Co-product reported for 2019.
			CY2020 Facility Total:		**11.8912**		**0.5480**	**CY2020 Co-product: 1,096 lbs/yr.**

Source: Gold Acquisition Corp. - Relief Canyon Mine: FIN 0904; Class 2 AQOP AP1041-2441; OPTC AP1041-3652; MOPTC AP1041-3585								
System Description: Mercury Retort (S2.009B/TU4.001)								
Hg	Not Reported	tpy	0.000003	lbs/hr	0.0011	362	0.0400	Mercury Retort emissions factor derived from December 2020 M219 stack test.
System Description: Carbon Regeneration Kiln (S2.011B/TU4.002)								
Hg	Not Reported	tpy	0	lbs/hr	0.0000	0	0.0000	Carbon Regeneration Kiln not yet constructed in 2020.
System Description: Electro-winning Cells & Barren Tank (S2.012 - S2.015/TU4.003 - TU4.006)								
Hg	Not Reported	gal/yr	0.00000122	lbs/hr	0.0029	2,374	0.0000	EW Cell #1 & Barren Tank emissions factor derived from Dec. 2020 M29 stack test.
System Description: Melt Furnace (S2.010B/TU4.007)								
Hg	Not Reported	tpy	0.000018	lbs/hr	0.0021	115	0.0000	Melt Furnace emissions factor derived from December 2020 M29 stack test.
System Description: Assay Laboratory (S2.012 - S2.015/DM3.001 - DM3.012)								
Hg					0.3400		0.0000	Potential to emit (PTE) of 0.34 lbs/yr, not actual - see DM Tech. Review
			CY2016 Facility Total:		0.3400		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		0.0000		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.0000		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.0000		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**0.3461**		**0.0400**	**CY2020 Co-product: 80.00 lbs/yr.**

Source: Nevada Gold Mines LLC (formerly Newmont Mining Corporation) - Long Canyon Project: FIN 0959; Class 2 AQOP AP1041-3586; MOPTC AP1041-3833								
System Description: Atomic Adsorption Spectrometer (DM3.001)								
Hg					0.0000		0.0000	Potential to emit (PTE) of 0.00000346 lbs/yr, not actual - see DM Tech. Review
			CY2016 Facility Total:		0.0000		0.0000	CY2016 Co-product: 0.00 lbs/yr. Source did not operate in 2016.
			CY2017 Facility Total:		0.0000		0.0000	CY2017 Co-product: 0.00 lbs/yr. Source did not operate in 2017.
			CY2018 Facility Total:		0.0000		0.0000	CY2018 Co-product: 0.00 lbs/yr. Source did not operate in 2018.
			CY2019 Facility Total:		0.0000		0.0000	CY2019 Co-product: 0.00 lbs/yr. Source did not operate in 2019.
			CY2020 Facility Total:		**0.0000**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr. Source did not operate in 2020.**

Source: Walker Lane Minerals - Isabella Pearl Mine: FIN 2039; Class 2 AQOP AP1041-3853; OPTC AP1041-3897; MOPTC AP1041-3895								
System Description: ADR Plant - Electro-winning Cells & Pregnant/Barren Tanks (S2.006 & S2.007/TU4.001 - TU4.003)								
Hg	Not Reported	tpy	8.053E-07	lbs/hr	0.0071	8,760	0.0000	EW Cells and P/B Tanks emissions factor derived from March 2020 M29 stack test.
System Description: ADR Plant - Mercury Retort (S2.008/TU4.004)								
Hg	Not Reported	tpy	4.673E-07	lbs/hr	0.0007	1,560	0.0407	Mercury Retort emissions factor derived from March 2020 M29 stack test.
System Description: ADR Plant - Carbon Regeneration Kiln (S2.009/TU4.005)								
Hg	30.80	tpy	1.966E-06	lbs/hr	0.0006	280	0.0000	Carbon Regeneration Kiln emissions factor derived from June 2020 M29 stack test.
System Description: Melt Furnace (S2.010/TU4.006)								
Hg	Not Reported	tpy	0.00001085	lbs/hr	0.0034	312	0.0000	Melt Furnace emissions factor derived from March 2020 M29 stack test.
System Description: Assay Laboratory (S2.006 - S2.009/DM3.001 - DM3.006)								
Hg					0.6220		0.0000	Potential to emit (PTE) of 0.622 lbs/yr, not actual - see DM Tech. Review
			CY2017 Facility Total:		0.6220		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.6220		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.6220		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**0.6337**		**0.0407**	**CY2020 Co-product: 81.40 lbs/yr.**

Source: Osgood Mining Company, LLC (formerly ATNA Resources, Inc.): FIN 0218; Class 2 AQOP AP1041-3086; MOPTC AP1041-3089								
System Description: Assay Laboratory (DM3.001 - DM3.010)								
Hg					0.0000		0.0000	Potential to emit (PTE) of 2.4156 lbs/yr, not actual - see De Minimis Tech. Review
			CY2013 Facility Total:		2.4156		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		2.4156		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		2.4156		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		0.0000		0.0000	CY2016 Co-product: 0.00 lbs/yr. Source did not operate in 2016.
			CY2017 Facility Total:		0.0000		0.0000	CY2017 Co-product: 0.00 lbs/yr. Source did not operate in 2017.
			CY2018 Facility Total:		0.0000		0.0000	CY2018 Co-product: 0.00 lbs/yr. Source did not operate in 2018.
			CY2019 Facility Total:		0.0000		0.0000	CY2019 Co-product: 0.00 lbs/yr. Source did not operate in 2019.
			CY2020 Facility Total:		**0.0000**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr. Source did not operate in 2020.**

Source: Tonkin Springs, LLC: FIN 0395; Class 2 AQOP AP1041-0482.03; MOPTC AP1041-2726

System Description: Assay Laboratory (DM3.001 & DM3.002)

Hg					0.0000		0.0000	De Minimis units removed from site, De Minimis Designation voided.
			CY2010 Facility Total:		4.9200		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		4.9200		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		4.9200		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		4.9200		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		4.9200		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		4.9200		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		4.9200		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		4.9200		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		4.9200		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.0000		0.0000	CY2019 Co-product: 0.00 lbs/yr. Source no longer subject to the NMCP.
			CY2020 Facility Total:		**0.0000**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr. Source no longer subject to the NMCP.**

Source: Mt. Hamilton, LLC: FIN 1723; OPTC AP1041-3500; MOPTC AP1041-3520									
System Description: Mercury Retort (S2.003/TU4.001)									
Hg		tpy		lbs/hr	0.0000		0.0000	Mercury Retort did not operate, not yet constructed.	
System Description: ADR Plant: Carbon Kiln (S2.004B/TU4.002)									
Hg		tpy		lbs/hr	0.0000		0.0000	Carbon Regeneration Kiln did not operate, not yet constructed.	
System Description: ADR Plant: Smelting Furnace (S2.005/TU4.003)									
Hg		tpy		lbs/hr	0.0000		0.0000	Smelting Furnace did not operate, not yet constructed.	
System Description: ADR Plant: Electro-winning Cells and P/B Tanks (S2.006 - S2.010/TU4.004 - TU4.008)									
Hg		tpy		lbs/hr	0.0000		0.0000	EW Cells and P/B Tanks did not operate, not yet constructed.	
System Description: Mercury Co-Product									
Hg					0.0000		0.0000	Facility-wide mercury co-product collected - Retort.	
System Description: Assay Laboratory (S2.018 - S2.023/DM3.001 - DM3.014)									
Hg					0.0000		0.0000	Potential to emit (PTE) of 4.11 lbs/yr, not actual - see DM Technical Review.	
			CY2015 Facility Total:		0.0000		0.0000	CY2015 Co-product: 0.00 lbs/yr.	
			CY2016 Facility Total:		0.0000		0.0000	CY2016 Co-product: 0.00 lbs/yr.	
			CY2017 Facility Total:		0.0000		0.0000	CY2017 Co-product: 0.00 lbs/yr.	
			CY2018 Facility Total:		0.0000		0.0000	CY2018 Co-product: 0.00 lbs/yr.	
			CY2019 Facility Total:		0.0000		0.0000	CY2019 Co-product: 0.00 lbs/yr.	
			CY2020 Facility Total:		**0.0000**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**	

Source: WK-Allied Hasbrouck LLC (Formerly WK Mining (USA) LTD): FIN 1915; AQOP Class 2 AP1041-3670; OPTC AP1041-3668; MOPTC AP1041-3669								
System Description: ADR Plant: Mercury Retort (S2.003/TU4.001)								
Hg		tpy		lbs/hr	0.0000		0.0000	Mercury Retort did not operate, not yet constructed.
System Description: ADR Plant: Smelting Furnace (S2.004/TU4.002)								
Hg		tpy		lbs/hr	0.0000		0.0000	Smelting Furnace did not operate, not yet constructed.
System Description: ADR Plant: Carbon Regeneration Kiln (S2.005/TU4.003)								
Hg		tpy		lbs/hr	0.0000		0.0000	Smelting Furnace did not operate, not yet constructed.
System Description: ADR Plant: Electro-winning Cells and P/B Tanks (S2.006 - S2.009/TU4.004 - TU4.007)								
Hg		tpy		lbs/hr	0.0000		0.0000	EW Cells and P/B Tanks did not operate, not yet constructed.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility-wide mercury co-product collected.
System Description: De Minimis Designation (No units listed)								
Hg					0.0000		0.0000	No DM Designation currently issued.
			CY2016 Facility Total:		0.0000		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		0.0000		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.0000		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.0000		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**0.0000**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**

Source: McEwen Mining, Inc.: FIN 2005; Class 2 AQOP AP1041-3799; OPTC AP1041-3800; MOPTC AP1041-3801								
System Description: ADR Plant: Carbon Regeneration Kiln, Electro-winning Cells, and Eluant (Pregnant)/Barren Tanks (S2.002 - S2.006/TU4.001 - TU4.005)								
Hg	Not Reported	tpy	0.0000369	lbs/hr	0.1322	3,584	0.0000	Carbon Kiln emissions factor (Kiln only) derived from October 2020 M29 stack test.
System Description: ADR Plant: Carbon Regeneration Kiln, Electro-winning Cells, and Eluant (Pregnant)/Barren Tanks (S2.002 - S2.006/TU4.001 - TU4.005)								
Hg	Not Reported	tpy	0.00000173	lbs/hr	0.0041	2,378	0.0000	Fluids Circuit emissions factor (Fluids only) derived from Oct. 2020 M29 stack test.
System Description: ADR Plant: Mercury Retort (S2.007/TU4.006)								
Hg	Not Reported	tpy	0.00000071	lbs/hr	0.0005	649	0.1808	Retort emissions factor derived from October 2020 M29 stack test.
System Description: ADR Plant: Refinery Furnace (S2.008A & S2.008B/TU4.007)								
Hg	Not Reported	tpy	0.0015	lbs/hr	0.1836	122	0.0000	Furnace emissions factor derived from October 2020 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		0.0000	Facility-wide mercury co-product collected (See Retort).
System Description: Assay Laboratory (S2.002 - S2.006/DM3.001 - DM3.009)								
Hg					1.9199		0.0000	Potential to emit (PTE) of 1.9199 lbs/yr, not actual - see DM Technical Review.
			CY2017 Facility Total:		0.0000		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.0000		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		3.4416		0.1605	CY2019 Co-product: 321lbs/yr.
			CY2019 Facility Total:		**2.2403**		**0.1808**	**CY2020 Co-product: 361.6 lbs/yr.**

<table>
<tr><td colspan="9">Source: Comstock Processing, LLC (formerly Plum Mining Company, LLC): FIN 0404; OPTC AP1041-2761; MOPTC AP1041-2690</td></tr>
<tr><td colspan="9">System Description: Mercury Retort (S2.025/TU4.001)</td></tr>
<tr><td>Hg</td><td>0.00</td><td>tpy</td><td>0</td><td>lbs/hr</td><td>0.0000</td><td>0</td><td>0.0000</td><td>Retort did not operate in 2019.</td></tr>
<tr><td colspan="9">System Description: Refinery Furnace (S2.026 & S2.026.1/TU4.002)</td></tr>
<tr><td>Hg</td><td>0.00</td><td>tpy</td><td>0</td><td>lbs/hr</td><td>0.0000</td><td>0</td><td>0.0000</td><td>Furnace did not operate in 2019.</td></tr>
<tr><td colspan="9">System Description: Mercury Co-Product</td></tr>
<tr><td>Hg</td><td></td><td></td><td></td><td></td><td>0.0000</td><td></td><td>0.0000</td><td>Facility-wide mercury co-product collected - Retort.</td></tr>
<tr><td colspan="9">System Description: Assay Laboratory (DM3.001 - DM3.012)</td></tr>
<tr><td>Hg</td><td></td><td></td><td></td><td></td><td>0.0309</td><td></td><td>0.0000</td><td>Potential to emit (PTE) of 0.0309 lbs/yr, not actual - see DM Technical Review.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2011 Facility Total:</td><td>0.0309</td><td></td><td>0.0000</td><td>CY2011 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2012 Facility Total:</td><td>0.2755</td><td></td><td>0.0000</td><td>CY2012 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2013 Facility Total:</td><td>0.9812</td><td></td><td>0.0003</td><td>CY2013 Co-product: 0.583 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2014 Facility Total:</td><td>0.0708</td><td></td><td>0.0070</td><td>CY2014 Co-product: 14 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2015 Facility Total:</td><td>0.2257</td><td></td><td>0.0000</td><td>CY2015 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2016 Facility Total:</td><td>0.2284</td><td></td><td>0.0000</td><td>CY2016 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2017 Facility Total:</td><td>0.0309</td><td></td><td>0.0000</td><td>CY2017 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2018 Facility Total:</td><td>0.0309</td><td></td><td>0.0000</td><td>CY2018 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2019 Facility Total:</td><td>0.0309</td><td></td><td>0.0000</td><td>CY2019 Co-product: 0.00 lbs/yr.</td></tr>
<tr><td colspan="3"></td><td colspan="2">CY2020 Facility Total:</td><td>0.0309</td><td></td><td>0.0000</td><td>CY2020 Co-product: 0.00 lbs/yr.</td></tr>
</table>

Source: Mineral Ridge Gold, LLC: FIN 0398; Class 2 AQOP AP1041-2733; MOPTC AP1041-2222								
System Description: Assay Laboratory (DM3.001 - DM3.011)								
Hg					2.9851		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2011 Facility Total:		2.1256	OK	0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		2.1256		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		2.9851		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		2.9851		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		2.9851		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		2.9851		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		2.9851		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		2.9851		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		2.9851		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**2.9851**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**

Source: Goldwedge, LLC - Goldwedge Mine (formerly Manhattan Mining Company): FIN 0373; Class 2 AQOP AP1041-1457; MOPTC AP1041-2303								
System Description: Assay Laboratory & Dore Smelting Furnace (DM3.002 - DM3.007)								
Hg					0.3624		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		0.0000		0.0000	CY2006 Co-product: 0.00 lbs/yr.
			CY2007 Facility Total:		4.1040		0.0000	CY2007 Co-product: 0.00 lbs/yr.
			CY2008 Facility Total:		4.1040		0.0000	CY2008 Co-product: 0.00 lbs/yr.
			CY2009 Facility Total:		4.1040		0.0000	CY2009 Co-product: 0.00 lbs/yr.
			CY2010 Facility Total:		4.1040		0.0000	CY2010 Co-product: 0.00 lbs/yr.
			CY2011 Facility Total:		4.1040		0.0000	CY2011 Co-product: 0.00 lbs/yr.
			CY2012 Facility Total:		4.4661		0.0000	CY2012 Co-product: 0.00 lbs/yr.
			CY2013 Facility Total:		4.4661		0.0000	CY2013 Co-product: 0.00 lbs/yr.
			CY2014 Facility Total:		4.4661		0.0000	CY2014 Co-product: 0.00 lbs/yr.
			CY2015 Facility Total:		0.3624		0.0000	CY2015 Co-product: 0.00 lbs/yr.
			CY2016 Facility Total:		0.3624		0.0000	CY2016 Co-product: 0.00 lbs/yr.
			CY2017 Facility Total:		0.3624		0.0000	CY2017 Co-product: 0.00 lbs/yr.
			CY2018 Facility Total:		0.3624		0.0000	CY2018 Co-product: 0.00 lbs/yr.
			CY2019 Facility Total:		0.3624		0.0000	CY2019 Co-product: 0.00 lbs/yr.
			CY2020 Facility Total:		**0.3624**		**0.0000**	**CY2020 Co-product: 0.00 lbs/yr.**

Source: Nevada Gold Mines LLC (formerly Barrick Goldstrike Mines, Inc.) Carlin Complex: FIN 0005; Class 1 AQOP AP1041-0739.02; OPTC AP1041-2805; MOPTC AP1041-2221								
System Description: North Roaster Mill Circuit #1 Air Pre-Heater and Dry Grinding Process (S2.204 & S2.205.01 - S2.205.12/TU4.001)								
Hg	2,802,489.49	tpy	0.0063	lbs/hr	49.97097	7,932	0.0000	Mill Circuit #1 emissions factor derived from May 2020 M29 stack test.
System Description: South Roaster Mill Circuit #2 Air Pre-Heater and Dry Grinding Process (S2.206 & S2.207.01 - S2.207.12/TU4.002)								
Hg	3,002,855.40	tpy	0.011	lbs/hr	90.2902	8,208	0.0000	Mill Circuit #2 emissions factor derived from May 2020 M29 stack test.
System Description: Roasters #1 & #2 (S2.209.1 & S2.209.2/TU4.003 & TU4.004)								
Hg	6,289,186.80	tpy	0.036	lbs/hr	287.622	7,990	0.0000	Roaster Circuit emissions factor derived from May 2020 M29 stack test. Testing was conducted during dual Roaster operations. Annual hours operated was reported as the same for both Roasters with emissions split evenly between the two Roasters in SLEIS.
System Description: North Roaster Circuit #1 Quenching Process (S2.210/TU4.005)								
Hg	Not Reported	tpy	0.0092	lbs/hr	73.57726312	7,998	0.0000	Quench Circuit #1 emissions factor derived from July 2020 M29 stack test.
System Description: South Roaster Circuit #2 Quenching Process (S2.211/TU4.006)								
Hg	Not Reported	tpy	0.007	lbs/hr	55.8704426	7,981	0.0000	Quench Circuit #2 emissions factor derived from July 2020 M29 stack test.
System Description: Analytical Assay Laboratory (S2.051.1/TU4.007)								
Hg	51.81	tpy	0.0026	lbs/hr	22.8384	8,784	0.0000	Assay Lab emissions factor derived from August 2019 M29 stack test.
System Description: Carbon Reactivation Kiln (S2.004.1/TU4.008)								
Hg	6,123.69	tpy	0.000024	lbs/hr	0.1357	5,654	0.0000	Carbon Kiln emissions factor derived from November 2020 M29 stack test.
System Description: Pregnant & Barren Strip Solution Tanks - Circuit A (S2.004.1/TU4.009 & TU4.011)								
Hg	Not Reported	gals/yr	0.000048	lbs/hr	0.2714	5,654	0.0000	P/B Tanks A emissions ducted in-line with the Carbon Reactivation Kiln.
System Description: Pregnant & Barren Strip Solution Tanks - Circuit B (S2.004.1/TU4.010 & TU4.012)								
Hg	Not Reported	gals/yr	0.000048	lbs/hr	0.2714	5,654	0.0000	P/B Tanks B emissions ducted in-line with the Carbon Reactivation Kiln.
System Description: Autoclave #1 (S2.015/TU4.013)						Acidic Operation		
Hg		tpy		lbs/hr	0.0000		0.0000	Autoclave #1 did not operate in 2020.
System Description: Autoclaves #2 & 3 (S2.016 & S2.017/TU4.014 & TU4.015))						Acidic Operation		
Hg	3,537,614.86	tpy	0.0027	lbs/hr	16.6955	6,184	0.0000	Autoclaves #2 & 3 emissions factor derived from June 2020 M29 stack test. Testing was conducted during dual Autoclave operations. Annual hours operated was reported as 6,184 for both Autoclaves.
System Description: Autoclaves #4 - 6 (S2.018 - S2.020/TU4.016 - TU4.018))						Acidic Operation		
Hg		tpy		lbs/hr	0.0000		0.0000	Annual emissions reporting documentation does not specify under which operating scenario testing was conducted, or whether dual scenario operations were undertaken. Therefore, all hours, throughput, and emissions are reported under Alkaline mode.
System Description: Autoclaves #4 - 6 (S2.018 - S2.020/TU4.016 - TU4.018)						Alkaline Operation		
Hg	11,371,535.70	tpy	0.0003	lbs/hr	2.4900	8,300	0.0000	Autoclaves #4 - 6 emissions factor derived from July 2019 M29 stack test. Testing was conducted during simultaneous operations. Annual hours operated was reported as 8,300 each for all three Autoclaves. Not clear in the facility's SLEIS report whether throughput is 3,790,511.891 total or each, reported here as each.
System Description: Mercury Retort #1 (S2.009/TU4.019)								
Hg	164.06	tpy	0.0000022	lbs/hr	0.0091	4,128	0.0000	Retort #1 emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort #2 (S2.010/TU4.020)								
Hg	164.06	tpy	0.0000015	lbs/hr	0.0071	4,714	0.0000	Retort #2 emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort #3 (S2.011/TU4.021)								
Hg	164.06	tpy	0.0000015	lbs/hr	0.0060	4,021	0.0000	Retort #3 emissions factor derived from August 2020 M29 stack test.
System Description: Mercury Retort #4 (S2.341/TU4.025)								
Hg	164.06	tpy	0.00000072	lbs/hr	0.0008	1,067	0.0000	Retort #4 emissions factor derived from August 2020 M29 stack test.

System Description: East & West Refinery Furnaces & Electro-winning Cells combined vented through a common carbon filter and stack (S2.013 & S2.014/TU4.022 & TU4.023)								
Hg	244.00	tpy	0.0034	lbs/hr	6.4838	1,907	0.0000	Furnaces/EW Cells emissions factor derived from August 2020 M29 stack test. Total throughput could be as high as 366 tpy, hard to tell based upon SLEIS submittal. Annual hours operated was reported as the combined total for both Furnaces.
System Description: Electro-winning Cells only (IA1.014/TU4.024)								
Hg	Not Reported	gals/yr	0.00076	lbs/hr	5.4732	7,202	0.0000	EW Cells emissions factor derived from August 2020 M29 stack test while the Furnaces were not operating. Total reported EW Cell operating hours were 7,202 hrs/yr. Unclear in reporting if this is net of combined furnace operations.
System Description: Resin-In-Leach (RIL) Elution Circuit Regeneration Tanks (S2.333.1 - S2.333.8/TU4.026 & TU4.027)								
Hg	3.97	1000gals/yr	0	lbs/hr	0.0000	158	0.0000	RIL Elution Circuit Regeneration Tanks were operated in 2020, but were reported as "not a thermal unit". Not exactly clear on this, but the emissions were likely minimal.
System Description: Resin-In-Leach (RIL) Electro-winning Circuit & Pregnant/Barren Tanks (S2.342.1 - S2.342.3/TU4.030 - TU4.032)								
Hg	Not Reported	gals/yr	0.000095	lbs/hr	0.3376	3,554	0.0000	RIL EW Circuit & P/B Tanks commenced operations 11/24/14. RIL EW Circuit emissions factor derived from October 2019 M29 stack test.
System Description: Mercury Co-Product								
Hg					0.0000		143.4590	Co-product generated/collected facility-wide.
System Description: Assay, Mill, Mill Met, Autoclave, Autoclave Met and Roaster Pumphouse Laboratories, Strip Circuit Area and Ore Fines Fee System (S2.051.1/DM3.001 - DM3.079).								
Hg					4.6866		0.0000	Potential to emit (PTE), not actual - see De Minimis Designation Tech. Rev.
			CY2006 Facility Total:		616.7650		98.5500	CY2006 Co-product: 197,100 lbs/yr.
			CY2007 Facility Total:		708.6590		58.6300	CY2007 Co-product: 117,260 lbs/yr.
			CY2008 Facility Total:		166.0557		87.3300	CY2008 Co-product: 134,660 lbs/yr.
			CY2009 Facility Total:		369.7831		61.8730	CY2009 Co-product: 123,746 lbs/yr.
			CY2010 Facility Total:		266.9336		60.1080	CY2010 Co-product: 120,216 lbs/yr.
			CY2011 Facility Total:		630.5519		59.9200	CY2011 Co-product: 119,840 lbs/yr.
			CY2012 Facility Total:		334.9836		44.4100	CY2012 Co-product: 88,820 lbs/yr.
			CY2013 Facility Total:		386.0257		50.6700	CY2013 Co-product: 111,708 lbs/yr.
			CY2014 Facility Total:		227.3012		53.4000	CY2014 Co-product: 117,727 lbs/yr.
			CY2015 Facility Total:		273.8005		66.4800	CY2015 Co-product: 146,563 lbs/yr.
			CY2016 Facility Total:		271.8309		126.6000	CY2016 Co-product: 279,105 lbs/yr.
			CY2017 Facility Total:		177.5724		148.0100	CY2017 Co-product: 326,306 lbs/yr.
			CY2018 Facility Total:		252.7577		153.8500	CY2018 Co-product: 307,705.93 lbs/yr.
			CY2019 Facility Total:		491.3440		106.8900	CY2019 Co-product: 213,780 lbs/yr.
			CY2020 Facility Total:		**617.0373**		**143.4590**	**CY2020 Co-product: 286,918 lbs/yr (reported in short tons). No calomel/ elemental breakout provided.**

CY 2020 Cumulative Totals		
Process Emissions (lbs/yr)		Co-Product (tpy)
956.03		**171.82**

CY 2020 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.

Co-product: 343,640 lbs/yr (171.82 short tons)

CY 2019 Cumulative Totals		
Process Emissions (lbs/yr)		Co-Product (tpy)
980.62		**145.16**

CY 2019 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.

Co-product: 290,320 lbs/yr (145.16 short tons)

CY 2018 Cumulative Totals		
Process Emissions (lbs/yr)		Co-Product (tpy)
730.74		**205.53**

CY 2018 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.

Co-product: 411,060 lbs/yr (205.53 short tons)

CY 2017 Cumulative Totals		
Process Emissions (lbs/yr)		Co-Product (tpy)
707.10		**186.56**

CY 2017 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.

Co-product: 403,406 lbs/yr (148.01 metric tons, 38.55 short tons)

CY 2016 Cumulative Totals		
Process Emissions (lbs/yr)		Co-Product (tpy)
696.68		**164.35**

CY 2016 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.

Co-product: 328,700 lbs/yr

CY 2015 Cumulative Totals			
Process Emissions (lbs/yr)		Co-Product (tpy)	CY 2015 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.
688.12		131.17	Co-product: 262,340 lbs/yr

CY 2014 Cumulative Totals			
Process Emissions (lbs/yr)		Co-Product (tpy)	CY 2014 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.
484.21		145.12	Co-product: 290,240 lbs/yr

CY 2013 Cumulative Totals			
Process Emissions (lbs/yr)		Co-Product (tpy)	CY 2013 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy. In some instances, 2012 test results were used due to invalidated 2013 test results.
748.63		111.57	Co-product: 223,140 lbs/yr

CY 2012 Cumulative Totals			
Process Emissions (lbs/yr)		Co-Product (tpy)	CY 2012 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.
1,393.42		115.95	Co-product: 231,900 lbs/yr

CY 2011 Cumulative Totals			
Process Emissions (lbs/yr)		Co-Product (tpy)	CY 2011 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.
1,607.96		106.77	Co-product: 213,540 lbs/yr

Note: **The total value is lower than actual industry-wide emissions due to a few thermal units which were unable to test in the reporting year and the absence of 2009 test data for Barrick Goldstrike's autoclaves under alkaline operating conditions. See 2009 Report for details.**

CY 2010 Cumulative Totals			
Process Emissions (lbs/yr)		**Co-Product (tpy)**	CY 2010 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.
1,134.15		**101.59**	Co-product: 203,180 lbs/yr

CY 2009 Cumulative Totals			
Process Emissions lbs/yr		Co-Product tpy	CY 2009 process emissions were solely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy. In general, testing went much better in 2009 than in 2008 with far fewer testing irregularities or instances where test results were invalidated.
1,336.46		**90.18**	Co-product: 180,360 lbs/yr

CY 2008 Cumulative Totals			
Process Emissions lbs/yr		Co-Product tpy	CY 2008 process emissions were largely derived using one consistent FRM testing methodology (Method 29). Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy. Some facilities had entire testing events, or in some cases just one or more runs of a test event, invalidated due to irregularities in testing protocol, poor sample handling procedures or laboratory errors. Yukon-Nevada Corporation - Jeritt Canyon Mine (formerly Queenstake Resources) did not test in 2008 due to the temporary NDEP ordered shutdown of the facility.
3,165.90		**102.93**	Co-product: 205,860 lbs/yr

CY 2007 Cumulative Totals			
Process Emissions lbs/yr		Co-Product tpy	CY 2007 process emissions were largely derived using one consistent FRM testing methodology (Method 29) with scattered M101A and OHM results used in lieu of M29 due to test schedule conflicts/logistics issues. Testing protocols were reviewed prior to test commencement and all final report submittals were reviewed to ensure reporting accuracy.
4,764.52		**97.68**	Co-product: 195,360 lbs/yr

CY 2006 Cumulative Totals			
Process Emissions lbs/yr		Co-Product tpy	CY 2006 process emissions and co-product values were accepted "as submitted" due to variability in testing methodology, emission calculation methods and/or the lack of current FRM test results.
4,468.15		**133.26**	Co-product: 266,520 lbs/yr

CURRICULUM VITAE

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Born November 17, 1950

Education:

University of California, Santa Barbara, CA	B.S. Chemistry	1972
University of California, Davis, CA	Ph.D. Agricultural Chemistry	1977

Employment:

Univ. of Nevada, Reno	2018-present	Professor Emeritus
	2008-2009	On leave for 11 months serving as Manager, Environmental Exposure Assessment, Valent USA Corporation, Science and Engineering Walnut Creek CA
	2007-2008, 2010-2018	President UNR Nevada Faculty Alliance
	1995-2006, 2010-2014	Director, Graduate Program in Environmental Sciences and Health
	1998-2004	Director, Center for Environmental
	1989-2018	Professor
	1983-89	Associate Professor
	1979-83	Assistant Professor
	1978-79	Lecturer
Environmental Protection Agency	1977-78	Research Chemist

Professional Societies:

American Chemical Society, Agrochemicals Division and Environmental Chemistry Division
American Association for the Advancement of Science

Awards:

Thornton Peace Prize (1982)
Junior Faculty Research Award (1982)
UNR Foundation Professor (1991)
Conservationist of the Year, Nevada Wildlife Federation (1995)
College of Agriculture Researcher of the Year (1998)
Friend of the Lake Award, League to Save Lake Tahoe (2001)

Other Professional Activities

Environmental Protection Agency: Competitive Grants Review Panel 1985-1995
Environmental Protection Agency: Advisory Committee on Mining Waste 1991-1993
Environmental Protection Agency: Stakeholder Advisory Committee on Commodity Mercury 2007
Nevada Division of Environmental Protection: Technical Advisory Committee on the Carson
River Superfund Site 1991-1994
American Chemical Society, Division of Environmental Chemistry: Chair of the Student
Awards Committee 1988-1992
American Chemical Society, Division of Environmental Chemistry: Chair of the Awards
Committee 1997-2002
UNR Environmental Studies Board: Chairman 1987-1990
Consultant to various public interest organizations, companies and law firms
Hydrology/Hydrogeology Graduate Faculty: Member 1989-present
Reviewer for numerous environmental chemistry journals
Co-owner and vice-president: Nevada Environmental Laboratories (Las Vegas and Reno)
1990-1999
Manager, Environmental Exposure Assessment, Valent USA, Corporation 8/2008- 8/2009

Courses Taught

Humans and the Environment: Environment 100
Environmental Toxicology: NRES 432/632
Environmental Chemicals: Exposure, Transport and Fate: NRES 433/633
Analysis of Environmental Contaminants: NRES 430/630
Risk Assessment, NRES 793C
Global and Regional Issues in Environmental Science: NRES 467/667

Community and Conservation Service Activities

City of Reno, Charter Review Commission: Chairman 1990-93
Peavine Grade School PTA: Co-President 1990-1992
Sierra Club Mining Committee (national): Co-Chair 1989-1992
League to Save Lake Tahoe Board of Directors: 1986-1999
Mountain and Desert Research Fund: 1987-2006
Dupont-Conoco Environmental Leadership Award in Mining Committee: 1989-1994
Nevada Interagency Reclamation Award Committee: 1990-1992
Washoe County School District Science Advisory Board: 1992-2000
Chairman, 1993-94
Earthworks: Board Member 1999-2019
Tahoe Baikal Institute: Board Member 1998-2019, Chair 2002-2003
Environmental Law Alliance Worldwide Board Member: 2000-2020
Great Basin Mine Watch: Board Member 1994-2021, Chair 2001-2006
Center for Science in Public Participation: Board Member 1998-present
Great Basin Institute, Board Member 2000-present, Chair 2001-present
United Nations Environmental Program Committee for Development of
a Code for Use of Cyanide in Mining: 2000-2002
Mining, Minerals and Sustainable Development, Assurance Group Committee
Member, 2000-2002
National Research Council committee on Methyl Bromide: 1999-2001

National Research Council committee on Mining Technology: 2000-2002
National Research Council committee on USGS Mineral Resources Program, 2000-2003
US Environmental Protection Agency Committee on Management of Mercury Stores in the U.S. 2007
Health Professional Advisory Board, an Advisory Board to the International Joint Commission, 2017-present

Research Interests: Remediation of mine waste contamination. Mining pit lake water quality. Fate and transport of organic compounds in soils and the atmosphere. Methods of remediation of gasoline contaminated soils; Photochemical transformation of organic contaminants on soil surfaces. Instrumental development of chromatographic systems. Development of arid lands biofuels, Effects of methane on drinking water; Photochemical production of perchlorate on sunlight irradiated surfaces, Production of nitrate on thermally treated soils and inorganic surfaces. Hemp chemistry.

Grants Received: (1982-present)

$ 14,550 "Atmospheric Photolysis of Pesticides," A Junior Faculty Research Award from the UNR Research Advisory Board, 1982.

$ 3,000 "Photolysis of CGA-41065," CIBA GEIGY Corporation, 1982.

$ 4,000 "Chemotaxonomy of Sagebrush Using High Performance Liquid Chromatography," Intermountain Research Station USDA, 1984.

$ 83,000 "Analysis of Bovine Tissue for Chlorinated Hydrocarbons," Environmental Protection Agency, 1984-85.

$ 18,300 "Photooxidation of Sulfide Containing Pesticides on Soil Surfaces," Western Regional Pesticide Impact Assessment Program, 1984.

$ 2,500 "Identification of Sagebrush Taxa Based on Liquid Chromatographic Analyses of Phenolics" Research Advisory Board, 1986.

$235,500 "Factors Affecting the Photolysis of Dioxins on Soil Surfaces," U.S. Environmental Protection Agency, 1986-89.

$ 15,160 "Vapor Phase Photolysis of Phorate," American Cyanamid Corporation, 1987.

$ 2,500 "Identification of Sagebrush Taxa Based on Liquid Chromatographic Analyses of Phenolics," UNR Research Advisory Board, 1987.

$ 48,792 "Upgrading Municipal Wastewater Effluents for Urban Water Reuse through Phytochemical Oxidations: System Development and Operational Criteria," U.S. Geological Survey, State Water Research Institute Program (Co-P.I. with Richard Watts), 1986-88.

$ 17,200 "Vapor Phase Photolysis of Malathion," American Cyanamid, 1988.

$ 16,460 "Aging Groundwater: A comparison of the Fluorocarbon Method to the Tritium Method," U.S. Geological Survey, State Water Research Institute Program (Co-P.I. with K. Sertic), 1988-89. (Competitive Grant, State of Nevada) Terminated 6-89.

$206,000 "In Situ Treatment of Organic Hazardous Wastes in Surface Soils Using Fenton's Reagent." U.S. Environmental Protection Agency (Co-P.I. with Richard Watts), 1988-89. (Competitive Grant, national)

$ 23,200 "Evaporation of Gasoline from Soils," Nevada Division of Environmental Protection Co-P.I. with Susan Donaldson), (Contract).

$ 50,000 "Photolysis of Pesticides on Soils," American Cyanamid Corporation (Unrestricted Grant, noncompetitive)

$ 15,600 "Vapor Phase Photolysis of Diazinon and Methyl Parathion" Western Region Pesticide Impact Assessment Program (USDA) (competitive) 1989-90

$ 30,000 "Interface for a Capillary electrophoresis Effluent and a Mass Spectrometer" Linear Corporation 1989-90. (Co P.I. with Murray Hackett) (contract)

$ 15,000 "UV-Gas Chromatographic Dectector" Linear Corporation 1990. (Co P.I. with Murray Hackett) (Noncompetitive grant)

$153,000 "Enhancement of Photodegradation of Pesticides in Soil by Transport Upward in Evaporating Water" (USGS Competitive) 1991-94

$ 50,000 "Pit Water from Precious Metal Mines" U.S. Environmental Protection Agency, 1992-94

$ 91,000 "Remediation of Acid Mine Drainage at Leviathon Mine" Lahontan Water Quality Control Board. (Contract, Co P.I. with Tom Wildman, Colorado School of Mines) 1992-94.

$159,000 " Ecological Toxicology of Metam Sodium and it Derivatives in the Terrestrial and Riparian Environments of the Sacramento River" California Fish and Game, 1992-1995 (G.C. Miller project, part of a larger project with George Taylor at the Desert Research Institute)

$43,092 “Atmospheric Transport and Deposition of Organophosphates and Other Pesticides as Input to Sierra Nevada Surface Waters” USDA-NRI. 1995-98. Co-P.I. with P.I. James N. Seiber. Task 2.

$80,427 “Linked Techniques for Contaminant Removal from Soil in Arid/Semiarid Environments” Dept. of Energy. 1993-96. Co.P.I with James N. Seiber.

$107,000 “Chemical Environmental Problems Associated with Mining” NIEHS 1993-96. Core B portion. This was a project of a larger Superfund Grant to UNR. James N. Seiber, P.I.

$36,900 “Protocol for Evaluation of Pesticide Photodegradation” Dow-Elanco. 1995-97. (Contract)

$45,000 “Photolysis of Pesticides” Dupont Chemical Company. 1995-98. Unrestricted gift to support ongoing research.

$275,000 “Remediation of Acid Mine Drainage at the Leviathan Mine”. Nevada Division of Environmental Protection. 1996-99

$5000 “Evaluation of Limnology and Water Quality of a Porphyry-Copper Pit Mine Lake” Public Resource Associates 1996.

$767,000 Geochemical, Biological and Economic Impacts of Arsenic and Related Oxyanions on a Mining-Impacted Watershed"   NSF-EPA, 1997-01

$46,000 "Remediation of Acid Mine Drainage at the Leviathan Mine". Lahontan Regional Water Quality Control Board, 2000-2001

$30,000 "Use of Sulfate-Reducing Bioreactors to Remove Zinc in Mine Drainage" Placer Dome Corporation. 2000-2001

$50,000 "Release of Gasoline Constituents from Marine Engines to Lake Tahoe"   Lahontan Regional Water Quality Control Board, 1998-1999

$70,000 "Impact of Marine Engine Exhaust on Pyramid Lake" U.S. Environmental Protection Agency, in cooperation with the Pyramid Lake Paiute Tribe. 2000-2001.

$570,000 "An Environmental Assessment of the Impacts of Polycyclic Aromatic Hydrocarbons in Lake Tahoe and Donner Lake" California Regional Water Quality Control Board, Lahontan Region. 2001-2003.

$126,000 "Operation of a Bioreactor at the Leviathan Mine" Contract with ARCO, 2001-2002

$75,000 Trifluroacetic Acid in Antarctic Ice, National Science Foundation 2001-2004

$190,500 "Mercury Deposition Associated with Mining, U.S. Environmental Protection Agency, 2002-2004

$53,000 Passivation of Acid Generating Rock at the Golden Sunlight Mine, Placer Dome Corporation 2002-2003

$520,000 "Operation of a Bioreactor at the Leviathan Mine" Contract with ARCO, 2003-2007

$250,000 "Risk Assessment and Fate of Polyacrylamide and Acrylamide in Irrigation Canals and Receiving Water" A subcontract from the Desert Research Institute on a project from the U.S. Bureau of Reclamation. 2004-2008

$55,000 Passivation of acid Generating rock, Freeport McMoran, 2009-2010

$75,000 Biofuel crops on arid lands, Co-P.I. U.S. Department of Energy, 2010-2011

$104,000 Development of a Good Neighbor Agreement for Mining, P.I. Newmont Mining Corporation 2012-2015

$498,000 Arid lands biofuels and bioproducts. P.I. USDA NIFA, 2013-2017

$75,000 Pesticide Safety Education Program for Nevada, CropLife America (2014-2017)

$38,000, Container composting of biosolids. P.I. Nordic Industries, 2015

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