EARTHJUSTICE

May 9, 2022

VIA EMAIL

Randy Bates
Director, Division of Water
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501-2617
E: randy.bates@alaska.gov

Re: Donlin Gold Certificate of Reasonable Assurance

Dear Mr. Bates:

Orutsararmiut Native Council respectfully requests that the Division of Water (the Division) consider the attached expert technical memoranda in connection with the pending remand in *Orutsararmiut Native Council v. Alaska Department of Environmental Conservation*, No. 3AN-21-06502CI. On April 14, 2022, Donlin Gold LLC submitted a letter and three technical memoranda in response to Orutsararmiut Native Council's comments in this matter. Donlin Gold's additional submissions were not authorized by the superior court's remand order. If the Division considers Donlin Gold's additional submissions, Orutsararmiut Native Council requests you also consider the following attached reports, which respond to Donlin Gold's new submissions:

1. Dr. Tom Myers, "Response to BGC Engineering, Review of BGC's Crooked Creek Stream Temperature Analysis—Response" (Apr. 29, 2022).
2. Dr. David M. Chambers, Response to BGC Engineering—Temperature of Treated Effluent" (May 5, 2022).
3. Dr. Glenn C. Miller, "Response to Comments on Mercury Releases from the Proposed Donlin Mine" (May 8, 2022).

Thank you for your careful attention to this important matter.

Sincerely,

Thomas S. Waldo
Attorney for Orutsararmiut Native Council

cc:

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April 29, 2022

Technical Memorandum
Prepared for: Earthjustice
Subject: Response to BGC Engineering, Review of BGC's Crooked Creek Stream Temperature Analysis –Response

BGC Engineering (BGC) completed the report, Analysis of Crooked Creek Stream Temperature (BGC 2021), to provide a quantitative analysis of the potential temperature effects of developing the Donlin Gold Mine on surface water temperatures in Crooked Creek. In support of Earthjustice's response, I prepared a technical memorandum titled, Surface Water Temperature Effects of the Proposed Donlin Project (Myers 2021). In response to Myers (2021), BGC Engineering submitted a memorandum titled Response to BGC Engineering, Review of BGC's Crooked Creek Stream Temperature Analysis –Response (BGC 2022). This technical memorandum responds to BGC (2022), hereinafter referred to simply as BGC.

The Donlin Gold Project Final Environmental Impact Statement (FEIS) contained only qualitative discussion of stream temperatures. BGC (2021) analyzed the change in temperature in Crooked Creek due to dewatering, removal of tributary flow, and discharges from treated dewatering water at the Donlin Mine to determine if the mine would cause water temperatures to exceed 55.4°F for egg/fry incubation or 59.0°F for migration and rearing. Water temperatures could rise if colder groundwater or streams with colder inflow no longer discharge into the creek or if discharges to the creek are warm enough to raise the temperature. Myers (2021) reviewed BGC (2021) and showed that the analysis underestimated the impacts of the project.

BGC' first comment concerns the data record. BGC quotes Myers's concerns about the period of record being just a select five-year period (2005, 2006, 2007, 2009, 2011) and claims that they are not making "assumptions about stream flow" (BGC, p 1) when they analyze the low flows of the record period. It is common in the scientific realm and a frequent regulatory requirement that low flow analysis be done of the 10-year return interval low flow. Having only a select five years of record, it is not possible to be analyzing a low flow that would be exceeded (flow less than that analyzed) at a ten-year or higher return interval. It is therefore common to apply a frequency analysis in the form of a probability distribution to the available data to estimate the ten-year low flow. It is not "speculation about whether lower or higher levels might be observed" (BGC, p 2), but good, common scientific practice to use a ten-year low flow estimate.

BGC also incorrectly claims that my “comment assumes that there is a direct correlation between streamflow and stream temperatures” (BGC p 2) without quoting any point in Myers (2021) at which I make such a point. BGC attempt to prove its point by discussing observations from just two days on which water and air temperatures were different. BGC does not understand correlation which means there is an identifiable relationship between the data based on multiple observations which consider a range of conditions; rather their comment suggests an exact correspondence that applies on all days based simply on one day’s observations. Many things affect the relation including cloud cover and antecedent heat in the water and surrounding soil which would result from lasting temperature effects of the preceding days. A statistical comparison between water and air temperature is the proper way to explain the various relationships and account for uncertainty.

BGC also claims that the data covers a “wide range of summer stream temperatures in Crooked Creek” (BGC p 2) and that Appendix C in BGC (2021) shows “[t]here was no predicted increase in average stream temperature for the other years analyzed” (BGC p 2). This is an incorrect statement because the graphs in BGC (2021) Appendix C show predicted temperature changes. Contrary to BGC’s claims, BGC (2021) does not provide a “reasonable interpretation of a range of conditions” (BGC, p 2).

BGC’s comment 2 questions my comment regarding BGC’s assumption of a linear flow to drainage area relationship. BGC’s analysis used a general concept acceptable during high flow periods, as evidenced by their use of a flood hydrology report (Watt 1989), to address the relationship between flow and area. During low flow periods, flow tends to enter the stream at discrete points, such as tributaries which have not dried due to it being a low flow period, and seep into the stream where pervious portions of the alluvial aquifer intersect with the stream. It is likely the stream loses flow at points where the water table falls below and disconnects from the bottom of the stream or just lowers and causes a gradient in the potentiometric surface to slope away from the stream. A graph of flow versus drainage area at low flow for a given stream often shows step increases at the points where still-flowing tributaries enter the stream and gradual positive or negative slopes reflecting groundwater inflows or discharges to or from the stream, respectively. Considering these relations is essential to understanding streamflow during dry conditions. A synoptic study as I suggested previously is necessary to map those relations as is necessary to estimate low flows along the stream.

In addition to simply using a flood flow concept when a low flow relationship is necessary, BGC makes a further error by considering the concept on a specific day’s flows, July 23, 2005, and not for a season’s flood runoff as the Watt (1989) was intended. In summary, BGC’s comment 2 incorrectly applies flow to area concepts on an improper temporal scale to make a meaningless sensitivity analysis. A synoptic study of the flows in the river reaches being considered is necessary to model flows and stream temperature during low flow periods; BGC's assumptions do not obviate those needs.

BGC's third comment quotes my extensive and detailed discussion of thermal relations between model nodes but then claims that "Dr. Meyer's (sic) comment is overly simplistic in that the measured discharge and stream temperature at CCAC implicitly accounts for the upstream radiation impacts on stream temperature" (BGC, p 3). BGC's claim that "accounting for thermal effects between model nodes *Q5* and *Qa* would result in lower modelled stream temperatures in the vicinity of American Creek (i.e., less conservative results)" ignores the fact that the ratio of stream surface area to flow would increase due to lower stream flows resulting from dewatering. Therefore, there would be less water to absorb the radiation entering the stream, as I implied in Myers (2021). It is irrelevant that Donlin would not affect the riparian vegetation – its activities decrease the stream flow which would result in less streamflow to absorb the existing thermal input to the stream and cause higher stream temperatures.

BGC's response regarding climate change is to ignore it as part of its analysis by claiming that they are considering the mine's effects on existing conditions even after acknowledging that the climate will warm. The baseline temperatures to which Donlin's activities will add heat to will increase and make the project more likely to heat the stream beyond standards. BGC essentially claims that Donlin will handle it if it affects stream temperatures. BGC lists several mitigations Donlin could implement but does not reference where Donlin has committed to any of these strategies. A monitoring plan (BGC, p 6) should be implemented regardless of climate change. Cooling the effluent water (BGC, p 7) would cost substantial amounts; Donlin would have to have the equipment ready to use on short notice, but there is no commitment as part of the permitting to do that.

Finally, BGC dismisses uncertainty by claiming in contrast to the evidence it presents that it has been considered. BGC claims that "in BGC's analysis of September 28, 2021, a loss in Crooked Creek water of 2 cfs was entered into the calculation, rather than the actual value of 0.79 cfs" (BGC, p 7). This differs from the original analysis as described in BGC (2021) which states that the removal of 2 cfs was due to the interception of a tributary flow (BGC 2021, p 12). The 0.79 cfs was removed from the hyporheic zone near Crooked Creek by drawing it to dewatering wells (BGC 2021, p 12). This does not account for the possibility that dewatering actually removes more groundwater discharge to Crooked Creek. As stated before, BGC has not accounted for the many uncertainties which could cause the analysis to underpredict the impacts of the project on stream temperatures.

All analyses of the effect of the proposed Donlin project on stream temperatures show that the project would increase streamflow temperatures to a level very close to the standards and could cause significant stress on the aquatic biota. As climate change manifests the baseline temperatures will increase and the project will stress the aquatic biota more frequently even during average flow years. During dry years and especially if Donlin removes more dewatering water than it currently plans to, the temperature increases will be devastating to the aquatic biota.

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CSP[2]

MEMORANDUM

Date: May 5, 2022

To: Earthjustice

From: David M. Chambers

Re: Response to BGC Engineering – Temperature of Treated Effluent

I have 40 years of experience in mineral exploration and development – 15 years of technical and management experience in the mineral exploration industry, and for the past 30+ years I have served as an advisor on the environmental effects of mining projects both nationally and internationally. I have a Professional Engineering Degree in physics from the Colorado School of Mines, a Master of Science Degree in geophysics from the University of California at Berkeley, and am a registered professional geophysicist in California (# GP 972). I received my Ph.D. in environmental planning from Berkeley. My recent research focuses on tailings dam failures, and the intersection of science and technology with public policy and natural resource management.

I have been asked by Earthjustice to comment on the applicability of some of the water treatment procedures proposed by BGC to mitigate the increases in water temperature that typically accompany mining and ore processing at the Donlin Mine.

In its project memorandum of April 14, 2022, BGC Engineering asserts that "*Donlin Gold can control the temperature of the treated effluent by managing the quantity (i.e., flow) of the water sources that are fed to the WTP* [Water Treatment Plant]." BGC Engineering suggests measures such as using groundwater rather than surface water sources, cooling treated effluent, releasing impounded water from the Snow Gulch Dam, adding groundwater from new wells outside the mine area, and assessing options to reduce the loss of water from Crooked Creek's hyporheic zone due to the dewatering wells.

Treating water, and consistently meeting compliance limits, is always a challenge. There are always excursions in the output from a water treatment plant, and the goal is insure there is enough margin between the actual output level and the compliance limit so that a violation does not occur.

Donlin will be no exception. Construction and operation of the proposed mine would entail: pumping enough groundwater to dewater a mine pit over 1800 feet deep and covering some two square miles; destroying all of American Creek and most of Anaconda Creek through excavation, filling, and diversions; creating a freshwater reservoir in Snow Gulch; creating two contact water dams in the waste rock pile to collect highly contaminated runoff from about three billion tons of waste rock; operating a plant to process 59,000 tons/day of ore that will discharge 17,000 gallons/minute of tailings slurry (processed ore residuals mixed with approximately an equal volume of contaminated wastewater) into a 3.7-square-mile tailings storage facility; pumping 14,000 gallons/minute of water from the tailings storage back to the processing plant for re-use in the ore processing; and collecting contaminated seepage from the tailings storage facility through a seepage recovery system. (FEIS 2018).

The water from these various sources will be directed either to the ore processing plant for use in processing the ore or to the water treatment plant for discharge to Crooked Creek. The ore processing plant requires an enormous amount of water and is designed to use water from the Snow Gulch reservoir, the two contact water dams, the pit dewatering wells, the tailings storage facility, the seepage recovery system, and the water treatment plant. The water treatment plant would treat water collected from the pit dewatering wells, the contact water dams, the tailings storage facility, and the seepage recovery system.

During normal operation about half of the water going through the water treatment plant will come from the dewatering wells. It is theoretically possible to increase this to approximately 80% of the treatment volume. (FEIS 2018). Because the well dewatering water is the lowest temperature water of all the sources for the water treatment plant, it is possible as BGC Engineering suggests, to increase the amount of well water going to the treatment plant to lower the temperature of the water treatment plant water. However, the implications associated with diverting more well dewatering water to the treatment plant are not just a simple temperature balance calculation.

First, the heat in the water must go somewhere. If it is not being discharged from the treatment plant, then it must go back into the mine water system, probably to the processing plant. This will gradually drive the water temperature of the remaining water higher, building up heat which must be accounted for the next time this water is headed for the treatment plant. This will make temperature control more difficult at exactly the time when temperature control is most critical.

Second, the dewatering well water has relatively less contamination than water from the TSF, seepage collection system, and other mine facility collection points (FEIS 2018). It should also be noted that temperature is not among the factors predicted in the many water quality prediction tables in the Final EIS (e.g. dewatering wells, TSF, seepage return system, etc. water), which do contain predictions for metals and other constituents. Using more dewatering well water to lower the temperature of the water treatment plant discharge will cycle the contaminants normally removed in the treatment plant back through the process facility. This could impact pH control, as well as lead to metal ion interference, in the processing plant. While this is unlikely to cause severe processing problems, it could affect the efficiency of the processing, and complicate control of the milling circuit. Maximizing gold recovery is the main objective of the processing plant, and the operation of everything else on the minesite will be focused to maximize gold recovery in the mill, including the water treatment plant. The additional gold recovery will easily pay the fines for a few temperature excursions at the water treatment plant.

Historically at most mines, there hasn't been much emphasis on temperature control when managing water treatment plant operation. The emphasis is typically on the level of metals in the discharge. I know of no examples of a mine where water has been redirected for stream temperature control, as BGC Engineering proposes. Nor does it appear that Donlin has conducted any studies to evaluate the feasibility of this proposal. BGC Engineering's mitigation proposals are all theoretical, and moving something from theory, to lab demonstrations, then into practical field application has historically been problematic for the mining industry.

Sincerely;

David M Chambers

David M. Chambers, Ph.D., P.Geop

References

BGC 2022. Review of BGC's Crooked Creek Stream Temperature Analysis – Response, BGC Engineering, April 14, 2022

FEIS 2018. Donlin Gold Project Final Environmental Impact Statement, US Army Corps of Engineers, April 2018

Response to Comments on Mercury Releases from the Proposed Donlin Mine

Glenn C. Miller, Ph.D., Consulting Environmental Chemist

May 8, 2022

These comments are a response to the Donlin Gold mine consultants regarding mercury releases from the proposed Donlin Mine in Alaska.

The first response is to the **Ramboll Gold response of April 14, 2022.** The first and much of the second page is simply a rationale of how the response was generated, with no additional supporting data. A response to their response is presented below.

3. Response to comments related to the tailings mercury: A primary criticism of the mercury study was the reliance on one single value for estimating the mercury concentrations in the tailings impoundment and thus the rates of volatilization from the tailings facility. An examination of data from both tailings facilities and heap leach operations at several mines indicates that mercury concentrations in both systems are highly variable and dependent on environmental conditions (e.g. sunlight) and the concentration of cyanide in the circulating water used to extract gold. A random example of mercury content as a function of season and cyanide concentration is provided in the following data set and was obtained from the NDEP regulatory files at a sampling site of a tailings facility at the Twin Creeks Mine called TW-O. WAD cyanide (Weak Acid Dissociable) is a common method of expressing active cyanide concentrations at mining sites.

Date of sample	WAD Cyanide conc. (mg/L)	Mercury conc. (mg/L)
July 30, 2020	0.05	<0.001 (not detected)
Dec. 7, 2020	8.27	0.506
Feb. 23, 2021	0.65	0.118
June 17, 2021	<0.01	<0.001 (not detected)

This is a reasonably typical set of data, although the distance from the mill discharge point was not indicated, nor was the time required for the discharged tails to reach that sampling point. But these data are supportive of the notion that during the hot summer months with full sunlight, the loss of mercury from the tailings fluid is occurring from either volatilization of the mercury or loss of cyanide through photochemical (sunlight) loss. This process is described in the Gustin lab papers. However, during the winter sampling periods both cyanide concentrations and mercury concentrations are elevated, comparatively.

The mercury content in the Twin Creeks ore is admittedly higher than at the Donlin site, but even the highest concentrations determined at single sampling site at Twin Creeks may well not be the highest concentration of either cyanide or mercury in other parts of the tailings facility. This sampling site is very likely some distance from the mill discharge, and the mill discharge site is expected to have the highest mercury and cyanide concentrations in the tailings fluids. The concentration of cyanide used for extraction of gold is generally well above 100 mg/L, and the highest cyanide concentration observed at this site was 8.27 mg/L of WAD cyanide. The data also show that mercury is solubilized when cyanide is present. No cyanide will almost always show very low mercury concentrations and high cyanide will show higher mercury concentrations.

This is admittedly only one set of data, although observed at other tailings facilities I have examined. The point of this data set is that using one concentration of mercury for the volatilization modelling is such a gross approximation that the results have effectively no reliability. The constant concentration of mercury used for the Donlin tailings volatilization of 0.073 mg/L does not have associated with it the cyanide concentration in the samples, and without that information, it is not possible to indicate how the mercury concentration will vary with cyanide concentrations at various times of the year, even at the discharge point.

Additionally, they argue that using the UNR sulfur reagent for capturing mercury in a solid form and settling in the tailings facility will further reduce soluble mercury. I have worked with this reagent at my university (UNR) and agree that it will capture mercury, but the use for which I am aware was to reduce the mercury in the air of the processing units for environmental health and safety concerns and was used primarily for heap leach applications. I have yet to see any data on how it will reduce mercury in a tailings application. The reagent is highly susceptible to oxidation, and almost certainly will not last a long time when added to a tailings facility, and is likely to lose its effectiveness. There is no indication that an estimate of how much of this reagent will be required, or the application method, or even the amount of reduction that will be observed at the Alaska site. I consider this statement to be highly speculative without any supporting data.

The bottom line is that there is no indication that mercury emissions will be measured at the site, and without this type of data, the emission of mercury at different times of the year is entirely speculative.

The Ramboll report suggests that the calculation of mercury emissions is so conservative that even if some level of uncertainty exists, the rate of mercury being emitted is not a worry. They present this assertion with effectively no basis and the uncertainty of the effectiveness of the UNR reagent and the uncertainty of the mercury cyanide factors and the uncertainty of the environmental factors are sufficiently large that the rate of mercury emissions is just as likely higher than that indicated in the report. The Donlin Mine will be located in a region that is very different than most other gold mines, and the potential impacts of mercury on the ecosystem problematic.

4. Response to comments related to linearity of stream response. Basically, what I indicated is that higher mercury emissions will result in higher concentrations in streams. I agree that soils sorb mercury, but it is entirely reasonable to indicate that higher mercury emissions from the mine sources will result in higher concentrations in the water. The processes where mercury is transferred to streams include direct impact on the streams, wash off from the soils to the streams and reemission of mercury sorbed on soils and deposition to the streams. The degree of linearity is a bit open to question, but there is no question that higher mercury emission from the mine site will increase mercury concentrations in the streams. Since the mercury loading to the streams is near the permitted (or problematic concentration) this concern remains important.

The Second response is from Air Sciences, Inc.

Assumption 1. Much of the data was obtained from the Ramboll report, and Air Sciences should have criticized their data set as well. I offer some comments on their comments. I am not sure where the data was obtained, but the impact of cyanide on concentrations of mercury in the tailings facility was not appropriately considered. The solubility of mercury is dramatically increased in the tailings facility in the presence of cyanide, and changes in mercury concentrations as the cyanide is oxidized will indeed reduce mercury content in the emissions, since in the absence of cyanide, mercury will be sorbed on sediments. However, the single example presented above of the Twin Creeks Mine tailings facility indicate the complex interactions of mercury and cyanide.

While the argument is presented that in a cold climate the tailings dam is frozen a good part of the year and mercury volatilization will be minimized, the cyanide and mercury cyanide complexes released from the mill during the winter are also stable and present an elevated concentration of mercury that can be emitted to the atmosphere in the spring when the tailings facility thaws. The concentration of mercury in the tailings facility (0.073 mg/L) used throughout the year simply does not consider the highly variable conditions that will exist at the mine.

The documents I have reviewed do not report the concentrations of cyanide that were present in those samples, and should be. I have studied the relationship between cyanide and mercury concentrations from heap leach operations, and the cyanide concentrations are critical for the evaluation of mercury concentrations. Yet, none of the data I have observed indicate the cyanide concentrations in those fluids. What will the cyanide concentrations be in the tailings fluids that are released from the mill?

Regarding Table 1 in the Air Sciences response, the uncertainty/variability of the data is exemplified from Twin Creeks, an operating mine. The tailings solids in Twin Creeks have a mercury content that is actually higher by almost a factor of 2, compared to the mercury content in the ore. This is, in general, not possible, since the tailings are what remains after the cyanide treatment, which removes most of the gold, and a percentage (largely unknown) of the mercury. Yet these data indicate that the tailings have a higher amount of mercury than the ore. I am not questioning the quality of the data, but these two data points indicate the heterogeneity and variability of the samples.

And, as discussed above the use of the UNR reagent is, in my opinion, untested in an actual situation, nor is the use described other than in a test sample.

Assumption 2. I am not arguing that the control systems employed are not effective. I have watched the Nevada gold mining industry improve the mercury removal performance for over 20 years, and the technology is indeed mature. However, I still argue that the emissions from the Donlin thermal facility are underestimated, primarily since the modeling exercise of the Donlin facility is based on other facilities, and although the technology is mature, there remains an elevated uncertainty in the emissions from the thermal facilities. As discussed above, this uncertainly is important since the mercury concentrations in the streams near the Donlin facility are near the maximum levels allowed.

Finally, there is no indication that mercury emissions from the Donlin facility are going to be measured, as is required by Nevada regulations. The company should be required to actually measure the concentrations from the thermal facilities on a regular basis, as well as the concentrations of mercury in the tailings facility on a time and space varying basis to actually determine what those emissions will be.

3.0 Donlin Gold Mercury Recovery. The response is critical of my use of 34,600 lbs of mercury recovered from the Donlin Mine. That number came from the Ramboll report, and they should have been criticized as such. But, since the issue was brought up by Air Sciences in their response, what is the amount of mercury that will be recovered? I did the calculation also and noted that the Ramboll report suggested that mercury recovery would be near quantitative (all of it captured as elemental mercury).

The comment that only 15% of the ore will be autoclaved is curious, since autoclaving oxidizes sulfidic ore, and it is the cyanide after autoclaving that dissolves the mercury, in a manner similar to gold recovery. Thus, the autoclaving comment is rather meaningless.

I do not disagree that a large, but uncertain, portion of the mercury will be left in the tailings, but this fact also suggests that the tailings, exposed to the atmosphere, will still have the potential for substantial emissions. Again, the amount of mercury emissions from the tailings facility is uncertain, and will remain uncertain unless regulations are put in place to require actual measurements.