EARTHJUSTICE

March 29, 2022

VIA EMAIL

Alaska Department of Environmental Conservation
Division of Water
Wastewater Discharge Authorization Program/401 Certification
555 Cordova Street
Anchorage, AK 99501-2617
E: dec-401cert@alaska.gov

Re: Donlin Gold Mine Certificate of Reasonable Assurance

Dear Alaska Department of Environmental Conservation,

Pursuant to the Order Granting Interlocutory Remand in *Orutsararmiut Native Council v. Alaska Department of Environmental Conservation*, No. 3AN-21-06502CI (Dec. 29, 2021), Orutsararmiut Native Council (ONC) submits these comments on the new draft studies commissioned by Donlin Gold LLC (Donlin) to evaluate the impacts of the proposed gold mine on stream temperatures[1] and mercury concentrations.[2]

For purposes of this letter, the following Kuskokwim-Yukon area tribes join ONC in these comments: Chevak Traditional Council, Chuloonawick Native Village, Native Village of Eek, Kasigluk Traditional Council, Native Village of Kwigillingok, Native Village of Nunapitchuk, and Tuluksak Tribal Council. ONC and the other tribes share common concerns about the impacts of the proposed gold mine on water quality, fish habitat, and subsistence uses. These concerns have prompted nearly unanimous opposition to the proposed mine among the tribal governments of the region, as reflected in the resolution of the Association of Village Council Presidents.[3] If the Department of Environmental Conservation ("the Department" or "ADEC") upholds the Certificate of Reasonable Assurance for the proposed

[1] BGC Engineering Inc., "Analysis of Crooked Creek Stream Temperature" (Draft, Sept. 28, 2021) (BGC 2021).
[2] Ramboll US Consulting, Inc., "Draft Report: Donlin Gold Mine Supplemental Mercury Modeling and Mass Balance Analysis" (Oct. 22, 2021) (Ramboll 2021).
[3] *See* Exhibit 3 (Association of Village Council Presidents, A Resolution Opposing the Further Development and Near Future Operation of the Donlin Creek Gold Mine, Resolution 19-09-10 (Sept. 2019) & K. Shallenberger, *AVCP delegates pass resolution against Donlin Gold Mine,* ALASKA PUBLIC MEDIA (Sept. 27, 2019)).

mine, the tribes of the Kuskokwim and Yukon River basins will have to live with the impacts forever, long after the mining company is gone. Donlin's draft reports fall far short of the assurance needed to support such a consequential decision.

I. Introduction and summary.

The draft studies confirm that there is no "reasonable assurance"[4] that the proposed mine will comply with Alaska's water quality standards for temperature or mercury. Both draft studies rely on models to estimate the impacts of the proposed mine decades in the future. Both models—like any model—are simplified representations of the real world subject to multiple sources of uncertainty. Even with the best models using verifiable data, actual outcomes will normally vary within a range from a model's estimate. In the case of Donlin's models, these deviations could be substantial due to multiple sources of uncertainty.

Both of Donlin's models predict outcomes almost exactly at the applicable standard. Given the large range of potential deviation from those outcomes, the models provide no basis to believe that compliance is any more likely than non-compliance. There is no "reasonable assurance" that either standard will be met.

Neither model is conservative. To the contrary, they were designed to eliminate the conservative assumptions of the Final Environmental Impact Statement (FEIS) for the Donlin Project, and they make simplifying assumptions that ignore real-world conditions that would increase the risk of violations. Thus, the Department must not treat them as risk-averse screening models.

Neither of the draft reports attempts to quantify or characterize the degree of uncertainty associated with the projections. Further, neither of them has been subject to normal analytical tools recommended to evaluate the results of a model, most importantly sensitivity analysis, uncertainty analysis, alternative scenarios, and peer review. In the absence of these analyses, the Department must assume a particularly high degree of uncertainty associated with these models and, therefore, a lack of reasonable assurance of compliance.

This lack of reasonable assurance is inherent in the models and would be apparent even if one assumes they were well-designed and supported by ample data. When one considers the shortcomings of the models, it is even more clear they provide no reasonable assurance of compliance. A leading expert in each of the two fields has reviewed the draft reports and found multiple sources of bias, suggesting that real-world outcomes are likely to be even worse than projected in the models.

[4] 40 C.F.R. § 121.2(a)(3) (2019).

While there is no reasonable assurance of compliance with either the temperature or mercury standard, the likelihood of complying with both is lower still. It is roughly like needing to flip heads in two consecutive coin tosses. The law requires a single finding of reasonable assurance as to all standards.

For these and other reasons, the Department should approach Donlin's new draft studies warily. They were prepared hastily, in response to litigation, with a strong incentive by Donlin to demonstrate compliance. Even with that strong incentive, the best they could do was to generate outcomes meeting the relevant standards by the thinnest of margins, revealing a high risk of non-compliance. By contrast, the FEIS underwent lengthy, multi-agency review, contains nuanced cautions about uncertainty wholly lacking from Donlin's rushed new reports, and finds significant risk of violating the temperature and mercury standards. In short, Donlin has failed to carry its burden of demonstrating reasonable assurance of compliance.

The Department should find that there is no reasonable assurance of compliance with water quality standards and rescind the Certificate of Reasonable Assurance.

II. Because the outcomes are so close to the standards, the inherent uncertainty of models precludes a finding of reasonable assurance.

Donlin's draft reports do not demonstrate reasonable assurance of compliance with temperature or mercury standards, because they are based on models with estimated outcomes almost exactly at the applicable standards. They are attempting to predict responses to conditions that do not yet exist and cannot be verified until the mine is built and operated decades in the future. Given the inherent uncertainty of models and outcomes on the boundary of non-compliance, the likelihood of compliance would be no better than that of non-compliance, even if the models were well designed.

Regulations of the U.S. Environmental Protection Agency (EPA) place the burden on Donlin as the applicant to provide information sufficient to support a finding of reasonable assurance.[5] Donlin's draft reports do not do so here. To the contrary, because they produce outcomes so close to the applicable standards and with such a high degree of uncertainty, they demonstrate that there is no reasonable assurance of compliance.

[5] *Id.* § 121.2(a)(2), (3) (2019). *See also* R. 9611, 9623 (EPA, Clean Water Act Section 401 Water Quality Certification at 18, 30 (2010)) ("an applicant must demonstrate that the proposed activity and discharge will not violate or interfere with the attainment of any limitations or standards identified in §401(a) and (d)"), ("The burden of proof remains on the applicant to show that the requirements of the [Clean Water Act] have not been and will not be violated as a result of the activity."). Record citations in this letter are to the agency record transmitted by the Department to the Superior Court in this matter on August 2, 2021.

A. Models are imperfect simplifications of reality.

Even the best model is an imperfect simulation of the real world, subject to error and uncertainty. As the aphorism goes, "all models are wrong, but some are useful."[6]

EPA has published a detailed guidance on the development, evaluation, and application of environmental models like those created by Donlin's contractors.[7] In it, EPA adopts the National Research Council's definition of a model: "A simplification of reality that is constructed to gain insights into select attributes of a particular physical, biological, economic, or social system."[8]

EPA repeatedly emphasizes the uncertainty associated with models and cautions users to treat them accordingly. Again quoting the National Research Council, the guidance explains: "Models will always be constrained by computational limitations, assumptions and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions."[9] EPA concludes, "The challenge facing model developers and users is determining when a model, despite its uncertainties, can be appropriately used to inform a decision."[10] In the succinct words of another paper, decision-makers should not use models as "truth machines."[11]

The FEIS cautions against mechanistic reliance on models, specifically in the context of the groundwater model on which both Donlin's temperature model and mercury model rely. "As is common with models of this type, . . . the model is used to simulate conditions (such as dewatering the mine pit) that do not currently exist. The amount and uncertainty of inaccuracies of these simulations are difficult to gauge."[12]

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[6] *See* W. Wagner *et al.*, "Misunderstanding Models in Environmental and Public Health Regulation," 18 N.Y.U. ENVTL. L.J. 293, 297 (2010) (Wagner *et al.*) (quoting G. Box & N. Draper, "Empirical Model-Building and Response Surfaces," 424 (1987)).

[7] Exhibit 4 (EPA, Guidance on the Development, Evaluation, and Application of Environmental Models (Mar. 2009) (EPA Guidance), https://www.epa.gov/measurements-modeling/guidance-document-development-evaluation-and-application-environmental-models).

[8] *Id.* at 9.

[9] *Id.* at 27; *see also id.* at 12 ("models are based on simplifying assumptions and cannot completely replicate the complexity inherent in environmental systems."); *id.* at 28 ("Because every model contains simplifications, predictions derived from a model can never be completely accurate and a model can never correspond exactly to reality.").

[10] *Id.* at 27.

[11] Wagner *et al.* at 295.

[12] R. 16967 (FEIS at 3.6-23) (citation omitted).

B. Both of Donlin's draft models generate estimated outcomes almost exactly at the applicable standard, providing no assurance of compliance.

The inherent uncertainty of the models is particularly important here, because both of Donlin's new draft models generate outcomes almost exactly at the applicable standard. If the inevitable deviations from the models' estimates are even slightly on the high side, the mine will violate the standards. Even if one assumes for the sake of argument that the models are well-designed, unbiased, and supported by ample data, given the inherent uncertainty of models and the near-miss outcomes, it is essentially a coin toss whether operation of the mine in the real world would comply with either standard.

1. The draft temperature model predicts temperatures within less than one degree Fahrenheit of the limit.

For temperature, the BGC Engineering draft model predicts outcomes within 0.6°F of the standard. Alaska has set water quality standards of 55.4°F (13°C) for egg and fry incubation and spawning.[13] The draft model predicts that mine operations, by withdrawing colder surface water and groundwater from the stream systems, will raise temperatures to 54.8°F in Crooked Creek at American Creek and 54.5°F in Crooked Creek at Crevice Creek.[14] These outcomes are just 0.6°F and 0.9°F below the standard, respectively.

Therefore, even if one accepts the model results without considering potential errors, omissions, or biases, the model provides no reasonable assurance of compliance with the standard. If the model is off by less than a degree, or if a future year is a degree warmer than the July 2005 comparison, the mine would violate the standard. Those are extremely small deviations from inherently imperfect estimates, providing no reasonable assurance that the mine will comply with the standard. Donlin has not carried its burden to demonstrate reasonable assurance.

2. Any mercury concentrations greater than those predicted in the draft model would violate the standard.

Donlin's new draft mercury model demonstrates no greater assurance of compliance than the temperature model. Because the waters near the mine have naturally elevated mercury levels and sometimes exceed the chronic criterion for mercury under pre-mine conditions, any non-trivial increase in mercury concentrations in the streams presents a significant risk of new violations of the chronic standard for aquatic life.

[13] 18 AAC 70.020(b)(10)(C).
[14] BGC 2021 at 23.

The mine would be developed in a "mercury belt" with high concentrations of mercury occurring naturally in the environment.[15] In samples taken from streams near the proposed mine from 2005 to 2015, 14 percent—80 out of 564 samples—exceeded 12 ng/L, the standard for a four-day chronic exposure to mercury.[16] Three of the samples had concentrations more than ten times the criterion.[17] Though they did not sample for four days continuously, the exceedances were "widespread" and clustered at certain times of the year and conditions.[18] "[M]ercury concentrations are generally higher during spring flow and storm flow conditions," and spikes may occur "due to precipitation and localized rock weathering conditions."[19]

The FEIS concluded, "These data suggest that existing concentrations of total mercury in surface water are sometimes elevated above the chronic criterion at locations throughout the Mine Site area…."[20] This point has never been disputed by the Department or by Donlin, and Donlin's new draft model by Ramboll US Consulting does not challenge that point.

Because the streams likely exceed the chronic criterion at times already, even a small increase in mercury concentrations would risk more violations, precluding any finding of reasonable assurance. Using conservative assumptions, the FEIS predicted a 40% increase in mercury concentrations,[21] which if true would certainly lead to substantial and frequent violations.[22] For these reasons, the only way Donlin could demonstrate reasonable assurance of compliance with the mercury standard would be if the company were to show that the mine would cause no significant increase in mercury concentrations in local waters.

The Ramboll draft mercury model seeks to achieve this result by eliminating the principal conservative assumptions of the FEIS.[23] By so doing, the model generates outcomes showing a tiny increase (0.8%) in Donlin Creek and tiny decreases at two locations in Crooked

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[15] R. 17749, 17269 (FEIS at 3.13-28, 3.8-35).
[16] R. 17040 (FEIS at 3.7-29); *see* 40 C.F.R. § 131.36(b)(1), row "8 Mercury," column B2, note "d." Because EPA has not approved Alaska's proposed aquatic life criteria for mercury, the EPA standard applies. R. 17017 (FEIS at 3.7-6).
[17] R. 17040 (FEIS at 3.7-29).
[18] R. 17163 (FEIS at 3.7-152).
[19] R. 17040 (FEIS at 3.7-29).
[20] R. 17162 (FEIS at 3.7-151).
[21] *Id.*
[22] R. 17170 (FEIS at 3.7-159) ("While the mean value is below the chronic [criterion] of 12 ng/L, the range of baseline data . . . indicates that this criteria [sic] would be exceeded in some areas within the 20-mile radius of the Mine Site some of the time."); *see also* R. 17162 (FEIS at 3.7-151) (mining operations "would likely cause an increase in exceedances of the 12 ng/L chronic criterion.").
[23] Ramboll 2021 at ES-1.

Creek (-1.6% at the Kuskokwim and -2.0% at Crevice Creek).[24] The report concludes that the projected increase at Donlin Creek is too small to produce any increase in the number of samples exceeding the chronic standard.[25]

As with the temperature model, these outcomes are far too close to the standard to provide any assurance of compliance when considering the inherent uncertainty. If any of the model's projections are low by even a small amount, the mine would cause an increase in the number and magnitude of exceedances over those that occur naturally, violating the standard. Given the inherent uncertainty in the model, it provides no reasonable assurance of compliance. Donlin has not carried its burden.

C. Donlin's draft models are not conservative.

Faced with the inherent uncertainty of models, one way to make sound use of them is to design them with conservative, risk-averse assumptions, so that errors would occur on the side of safety.[26] Donlin's contractors did not do that here. Rather, they attempt to demonstrate bare compliance with the applicable standards by omitting or eliminating conservative assumptions, resulting in a high risk of violating the standards.

1. The draft temperature model ignores the likelihood of warmer stream temperatures in the future from several causes.

The BGC Engineering draft temperature model omits real-world conditions that would result in higher temperatures, and it is therefore not conservative. It is a simple mixing model: It merely estimates the temperatures and volumes of the water entering the stream from different sources (based on just six years of data) and adds them up.[27] This simple approach misses several real-world considerations that would raise temperatures. ONC emphasizes three of them here.

First, the draft model is based on only six years of overlapping historic data and makes projections based on the warmest month in that period, July 2005.[28] Implicit in this is that the warmest month in the 27-year life of the mine will be no warmer than July 2005, but that is highly unlikely. With so many more years of operation than of data, it is likely there will be warmer years and correspondingly warmer stream temperatures. By relying only on a highly

[24] *Id.* at 3-28. The model shows much more substantial reductions in American and Anaconda creeks, but that is because those streams are mostly eliminated by the mine.
[25] *Id.* at 3-31.
[26] *See*, *e.g.*, Exhibit 4 at 30 (EPA Guidance).
[27] BGC 2021 at 5, 11.
[28] *Id.* at 5, 15.

limited data set, the draft temperature model fails to make projections for foreseeably higher temperatures.[29]

Temperature records from the National Weather Service (NWS) support the conclusion that there have been and likely will be months warmer than July 2005. The nearest station with temperatures reported online is Bethel. In Bethel, as at Crooked Creek, July 2005 had the warmest mean average temperatures among the months with data from Crooked Creek: 2005-2009 and 2011.[30] This confirms that Bethel and Crooked Creek experience similar weather patterns. However, looking at just a few additional years of data from Bethel, there were five months with average temperatures warmer than July 2005: two of them earlier (July and August 2004), and three of them later (July and August 2016, and July 2019).[31] The same pattern holds true for Bethel's mean maximum temperatures: July 2005 was highest among the years in the BGC model, but there were five months with higher mean maximums in other years, both earlier and later (July and August 2004, June 2015, July 2016, and July 2019).[32] It is all but certain that there have similarly been warmer months at Crooked Creek and that there will be more in the future.

Stream temperature records farther downstream in Crooked Creek also confirm this conclusion. Federal agencies maintain stream temperature records from Crooked Creek at the Crooked Creek Airport, downstream of the sites modeled by Donlin.[33] While the warmest Crooked Creek temperature modeled by Donlin based on July 2005 readings was 52.6°F (11.4°C),[34] the downstream site database includes 20 readings higher than that, all but two of which were in 2018 and 2019.[35] The highest was 54.7°F (12.6°C), just 0.7°F below the standard.[36] On the basis of these high readings, the Department has proposed to list Crooked Creek on Alaska's impaired water body list for temperature in Category 3, "Waters for which there is not

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[29] *See also* Exhibit 6 at 2 (T. Myers, "Surface Water Temperature Effects of the Proposed Donlin Project" (Nov. 24, 2021)) (Myers 2021) ("BGC presents no analysis as to the frequency that the low flows or high temperatures observed in summer 2005 have occurred so the predictive power of that knowledge is limited.").

[30] BGC 2021 at 5; Exhibit 8 at 1 (NWS, Bethel Temperature Data 2000-2022) (NWS 2022).

[31] Exhibit 8 at 1 (NWS 2022).

[32] *Id.* at 2.

[33] Exhibit 7 (National Water Quality Monitoring Council, Water Quality Portal, excerpt for Crooked Creek, Alaska (USGS-15304010)) (Alaska waters database). This exhibit is an excerpt from a massive federal database available at https://www.waterqualitydata.us/. The Department formerly posted the Alaska waters in an Excel spreadsheet on its website. *See* Exhibit 2 at 3 (ADEC, 2022 Draft Integrated Report, Questions and Answers). The excerpt in Exhibit 7 includes just the temperature readings from Crooked Creek (USGS-15304010), sorted from warmest to coldest.

[34] BGC 2021 at 15, 23.

[35] Exhibit 7 (Alaska waters database).

[36] *Id.*

enough information to determine their status."[37] By withdrawing colder surface water and groundwater from Crooked Creek at the mine site upstream, the mine would only warm the water further. If there is not enough information to determine whether Crooked Creek downstream of the mine currently complies with the temperature standard, then it is not logically possible to support a finding of "reasonable assurance" that the proposed mine will not cause violations.

The second respect in which the draft temperature model is not conservative is that it fails to consider the effects of future climate change. As discussed, the model has insufficient data to reflect even recent recorded warmer temperatures. Due to climate change, temperatures will be warmer in the future, which could affect stream temperatures in two ways: "It could decrease flows during warm, dry periods and increase the air temperature and therefore the flux of heat from the air to the water. Both would increase the stream temperature."[38]

While climate change will generally warm the whole planet, temperature increases are expected to be greater on average at the high latitudes of the proposed mine. The U.S. Global Change Research Program predicts that the Yukon-Kuskokwim region will warm significantly over the course of this century.[39] At Crooked Creek, the projected average monthly temperature increases range between 3-7°F for 2030-2039 and 4-11°F for 2060-2069 under the low emissions scenario (RCP 4.5).[40] Under the high emissions scenario (RCP 8.5), the ranges are 3-9°F and 7-14°F, respectively.[41]

By failing to address future climate change, Donlin's draft temperature model overlooks foreseeably higher temperatures that would bump the mine's impacts well over the standard.

The third respect in which the model is not conservative is that, as a simple mixing model, it fails to consider thermal effects, *i.e.*, warming that may occur from atmospheric radiation and air temperatures warmer than the water. For example, the model assumes that the temperature of Crooked Creek just below American Creek (node Q3) will equal the temperature at Crooked Creek just above Anaconda Creek (node Q1), meaning that no

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[37] Exhibit 1 at 2, 11 (ADEC, 2022 Draft Integrated Report, Fact Sheet (Jan. 24, 2022)).
[38] Exhibit 6 at 3 (Myers 2021).
[39] *See*, *e.g.*, Exhibit 9 at 16, Fig. 26.1 (U.S. Global Change Research Program, Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States (Rev. Mar. 2021)) (showing projected average annual temperatures rising between 6-8°F under the lower Representative Concentration Pathway (RCP) 4.5 scenario and 10-12°F under the higher RCP 8.5 scenario by 2070-2099).
[40] *See* Exhibit 10 at 1 (University of Alaska Fairbanks, Scenarios Network for Alaska, Community Climate Charts, Crooked Creek (Qipcarpak), Alaska, https://snap.uaf.edu/tools/community-charts (last accessed Feb. 3, 2022)).
[41] *See id.* at 3.

warming would take place as the stream flows between these tributaries.[42] The distance between the intersections of these tributaries with Crooked Creek is about three miles as the crow flies,[43] which is about eight stream miles on this winding creek.[44] On a warm day, over a distance of eight miles, there will clearly be some warming from the ambient air.[45]

The draft temperature model claims to make but one conservative assumption: that the water removed from the creek by the dewatering wells would be as cold as average groundwater.[46] To the extent this assumption is conservative, it does not offset the decidedly non-conservative omissions described above.

Because Donlin's draft temperature model predicts temperatures less than one degree Fahrenheit below the standard, even a slightly higher temperature from any of these three causes—unmeasured warmer years, climate change, and thermal effects—could easily bump the stream temperatures over the standard. Taken together, violations are a near certainty. Thus, the draft model is not conservative, and there is no "reasonable assurance" that the mine will comply with the temperature standard. Donlin has not carried its burden of demonstrating reasonable assurance of compliance.

2. The draft mercury model eliminates conservative assumptions and aggressively seeks to minimize potential mercury emissions.

Nor is the Ramboll draft mercury model conservative. To the contrary, its central stated purpose is to eliminate the principal conservative assumptions of the model used in the FEIS,[47] to be "more accurate" rather than risk-averse.[48] While Ramboll claims to make a few remaining conservative assumptions among the countless inputs to the complex, multi-part model,[49] the dominant feature of the model is an aggressive attempt to downplay estimated emissions of mercury. Compared to the FEIS, it claims a 72% decrease in processing emissions and a 73% decrease in tailings emissions, which are by far the two largest sources of emissions from the mine.[50] As discussed further below, both revised calculations are implausibly low.

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[42] BGC 2021 at 10, 11.
[43] *See id.* at 6.
[44] The FEIS reports that this segment, called CR-R4, *see* R. 17730 (FEIS Fig. 3.13-1), has a sinuosity of 2.7. R. 017734 (FEIS at 3.13-13, Tbl. 3.13-1). Three miles in a straight line thus includes 8.1 stream miles (3 x 2.7 = 8.1).
[45] *See* Exhibit 6 at 3 (Myers 2021).
[46] BGC 2021 at 12.
[47] Ramboll 2021 at ES-1, 2-2, 3-9 to 3-10, 3-13 n.15.
[48] *Id.* at ES-1.
[49] *Id.* at 3-12 (disregarding the use of settling reagents in tailings water), 3-20 (disregarding in-pit retention of fugitive dust), 3-28 (assuming effluent will contain the maximum allowed mercury level).
[50] *Id.* at ES-1 & ES-2, Tbl. ES-1.

It is potentially misleading for Ramboll to state that it was "conservative" to use the years of peak projected mercury emissions from the tailings disposal site and fugitive dust.[51] The law requires considering peak conditions. Alaska's water quality standards apply on every day of every year for the life of the mine and beyond.[52] While the Department may grant short-term variances under certain conditions,[53] it has not done so here and Donlin has not requested one. In the absence of a variance, any model must therefore make projections for the point in time at which mercury concentrations would be expected to be greatest. The failure to do so would offer no reasonable assurance of compliance when concentrations are highest. Modeling for this legal requirement is therefore not particularly "conservative." And because the model predicts compliance by only the thinnest of margins at that time, the uncertainty inherent in the model precludes a finding of reasonable assurance. Donlin has failed to carry its burden.

D. The draft models lack basic analysis to assess reliability in the face of uncertainty.

Both of Donlin's draft models make the elementary mistake of presenting each outcome as a single, highly precise number—such as 54.8°F at the American Creek inflow[54] and a 0.8% increase in mercury in Donlin Creek[55]—with no attempt to characterize the degree of uncertainty. It is simply not possible to predict temperatures to the nearest 0.1°F or mercury concentrations to the nearest 0.1% in streams 30 years in the future following massive alterations to complex natural systems. By asserting such outcomes, both models imply a measure of precision far beyond their capability, and indeed beyond the capability of any model.

Neither report discloses even such basic measures of uncertainty as standard deviation, standard error, or confidence intervals.[56] And those measures alone would not be sufficient, even if they had been included: "Simply putting error bars around the final result is inadequate in capturing the full uncertainties and complexities of models."[57] Nor does either model present

[51] *Id.* at 3-14, 3-20.
[52] *See generally* 18 AAC 70.010.
[53] 18 AAC 70.200, .205.
[54] BGC 2021 at 15.
[55] Ramboll 2021 at 3-31.
[56] *See*, *e.g.*, Exhibit 4 at 83-84 (EPA Guidance).
[57] Wagner *et al.* at 352.

alternative scenarios, another recommended tool.[58] Both models have multiple inputs that are estimates of future values, each of which is subject to its own standard deviations, standard errors, and confidence intervals that would affect the model's ultimate outcome, but the reports disclose little or none of this. By presenting a single, implausibly precise number as the definitive outcome, both draft reports present their models as "truth machines," a practice cautioned against by EPA[59] and other commentators.[60]

EPA's modeling guidance establishes best practices to evaluate the uncertainty inherent in models for environmental decision-makers. These safeguards include corroboration, sensitivity analysis, uncertainty analysis, and peer review,[61] none of which were undertaken, at least in any meaningful way, for either of Donlin's draft reports. Of course, corroborating the models with data from actual conditions is impossible, since those conditions will exist only after the massive excavations, diversions, pumping, filling, processing, and discharges associated with the mine. In these circumstances, the other tools—including sensitivity analysis, uncertainty analysis, and peer review—are even more important.[62]

An example of better treatment of uncertainty is the discussion of the groundwater flow model in the FEIS. It acknowledges the unknown data, tests different scenarios with different outcomes, and cautions readers "that the model results showing impacts to Crooked Creek should be regarded as uncertain, and that the analysis of project effects should include scenarios other than the base case (e.g., the sensitivity analyses described above)."[63] Neither of Donlin's new draft reports include any such evaluation or disclosure, even though both reports rely on that very model and countless other uncertain inputs.

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[58] *See* Exhibit 4 at 39 (EPA Guidance) ("To facilitate communication of model uncertainty, the committee recommends using hybrid approaches in which unknown quantities are treated probabilistically and explored in scenario-assessment mode by decision makers through a range of plausible values."); Wagner *et al.* at 352 ("[M]odels should be created with a variety of assumptions and scenarios that illustrate the differences these assumptions and choices make for policymakers.").

[59] Exhibit 4 at 27 (EPA Guidance) ("Models . . . can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions.").

[60] Wagner *et al.* at 295-96.

[61] Exhibit 4 at 29 (EPA Guidance).

[62] *Id.* at 37 ("In many cases, collecting independent datasets for formal model corroboration is extremely costly or otherwise unfeasible. In such circumstances, model evaluation may be appropriately conducted using a combination of other evaluation tools discussed in this section.").

[63] R. 16980-82 (FEIS at 3.6-36 to 3.6-38).

1. The draft temperature model contains insufficient evaluation of uncertainty.

The BGC Engineering draft temperature model includes just one sensitivity analysis on a single variable in the model: the temperature of the effluent discharge.[64] Testing a single input in the model is not sufficient as a meaningful sensitivity analysis, because it does not enable the user to compare and evaluate the model's multiple sources of uncertainty: "Sensitivity analysis is recommended as the principal evaluation tool for characterizing the most and least important sources of uncertainty in environmental models."[65] It should be used "early and often."[66] To test just a single input, then, largely misses the point.

To its credit, the draft temperature model also includes two paragraphs identifying multiple sources of uncertainty associated with the model and acknowledging the model does not account for them.[67] This is an important acknowledgement, and it reinforces the conclusion that the outcome should be treated as subject to a high, though un-evaluated, degree of uncertainty.

Even without such basic analytical tools as standard deviations, confidence intervals, error bars, sensitivity analysis, uncertainty analysis, alternative scenarios, or peer review, the draft temperature report makes clear that there is no reasonable assurance the standard will be met. As discussed above, the projected temperatures are almost exactly at the standard, despite a model design disregarding important factors that would result in higher temperatures. Rigorous evaluation of the draft model would only confirm the conclusion that there is no reasonable assurance of compliance.

Dr. Tom Myers—a consulting hydrologist with decades of experience assessing impacts of mines, including mine dewatering and groundwater modeling[68]—tested the sensitivity of the model to changes in just a few of the model inputs. He demonstrates that even small, plausible changes in the inputs to the BGC Engineering draft model would lead to violations of the standard. The draft model recognizes that the proposed mine's tailings facility would eliminate most of the flow from Anaconda Creek (Q2).[69] But if the flow drops to zero (as is possible given uncertainties in future streamflows), the tributary's cooling effect on Crooked Creek would disappear and raise the temperature in Crooked Creek (Qa) to 54.9°F, violating the standard.[70] The draft model assumes (with no data) that effluent temperatures from the wastewater treatment facility will not be high enough to affect the stream, but if discharges are much

[64] BGC 2021 at 18.
[65] Exhibit 4 at 39 (EPA Guidance).
[66] *Id.* at 16.
[67] BGC 2021 at 22.
[68] Exhibit 6 at 7-18 (Myers 2021).
[69] BGC 2021 at 2, 11.
[70] Exhibit 6 at 4 (Myers 2021).

warmer than assumed, the standard would be violated.[71] If thermal effects assumed not to exist by the draft model warm Crooked Creek just a couple degrees between tributaries, the standard would be violated.[72] If the stream temperature in Anaconda Creek (Q2) is less than a degree warmer than the modeled temperature, it would warm Crooked Creek (Qa) above the standard.[73] If the background water temperature is less than a degree higher than in July 2005, the temperature standard would be violated.[74]

For these reasons, Myers concludes that "there are so many assumptions necessary to keep the temperatures from exceeding the standards that it is likely that future stream temperatures will exceed the standards, especially as climate change increases the background temperatures that the mine will only increase with its effects."[75] There is no reasonable assurance that the proposed mine will comply with the temperature standard. Donlin has not carried its burden of demonstrating reasonable assurance of compliance.

Dr. Myers' report is attached to this letter as Exhibit 6. ONC incorporates it by reference and requests that the Department provide a complete response to it as if set out here in its entirety.

2. The draft mercury model contains insufficient evaluation of uncertainty.

While the draft temperature model at least acknowledges sources of uncertainty, the Ramboll draft mercury model concedes no such limitations. Nor does it contain any sensitivity analysis or any of the other safeguards recommended by EPA or other commentators. This is not for lack of need. The mercury model is much more complex than the temperature model and has correspondingly many more sources of uncertainty. The FEIS acknowledges, correctly, that "[p]redicting changes in mercury concentrations in aquatic systems is challenging…."[76]

The draft mercury model is a vastly more ambitious undertaking than the temperature model. While the temperature model simply adds up the estimated temperatures and volumes of different inputs to the stream system, the mercury model attempts to capture the effects of countless inputs from diverse natural and mining-induced physical, chemical, and thermal processes. The Ramboll draft model: estimates the mercury concentrations in the ore, the pit and the waste rock;[77] estimates the resulting fugitive gas emissions, stack emissions, and fugitive dust emissions, including wind erosion, from dozens of individual sources at the mine

[71] *Id.* at 3, 5.
[72] *Id.* at 6.
[73] *Id.*
[74] *Id.*
[75] *Id.*
[76] R. 17162 (FEIS at 3.7-151).
[77] Ramboll 2021 at 2-3, 3-16 to 3-17.

(*see* Appendix A hereto);[78] estimates the particle size distribution of the dust sources;[79] estimates the mercury retention rate in the soils, relying on lake sediments extrapolated to a stream system and on data from ecoregions deemed similar to the Crooked Creek watershed;[80] estimates mercury sources in surface waters by geochemical fingerprinting deduced from mercury-to-aluminum ratios;[81] estimates upstream streamflows relying in part on data from the CCAK monitoring station;[82] estimates upstream mercury mass loading in the stream also based on data from the CCAK site;[83] estimates baseline atmospheric deposition and geologic loading of mercury;[84] estimates reductions in mercury mass loading due to diversions of American and Anaconda creeks;[85] estimates mercury mass loading from the proposed wastewater treatment plant discharges;[86] and, from these estimates, calculates ultimate estimates of mass loading and mass balance at five monitoring stations in the Crooked Creek watershed, for both baseline conditions and mine operating conditions.[87]

At each of these many model inputs, estimates were made, though there is almost no disclosure of the standard deviations, standard errors, confidence intervals, or any other measures of the uncertainty each of these estimates contributes to the model's outcomes. For numerous inputs, the model relies on other models. Examples named in the Ramboll report include:

- EPA mercury modeling database for stack emissions from boilers, heaters, and incinerators.[88]
- ENVIRON modeling of atmospheric mercury deposition flux.[89]
- Streamflow and loading regression model to fill in gaps in data.[90]
- A conceptual terrestrial model of the ecosystem.[91]
- Least squares linear regression model for mercury retention rate in sediments.[92]
- CALPUFF model for particle sizes for dry and wet deposition.[93]

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[78] *Id.* at 3-12 to 3-21.
[79] *Id.* at 3-10 to 3-11.
[80] *Id.* at 3-3 to 3-6.
[81] *Id.* at 3-6 to 3-9.
[82] *Id.* at 3-24 to 3-25 & ES-4, Fig. ES-2.
[83] *Id.* at 3-25.
[84] *Id.* at 3-26.
[85] *Id.* at 3-26 to 3-28.
[86] *Id.* at 3-28.
[87] *Id.* at 3-28 to 3-31.
[88] *Id.* at 3-18 to 3-19.
[89] *Id.* at 2-2, 3-9.
[90] *Id.* at 2-4, 3-24.
[91] *Id.* at 3-1, 3-26.
[92] *Id.* at 3-3.
[93] *Id.* at 3-11, 3-22.

- Geochemical modeling of the tailings filtrate water from the Feasibility Pilot Phase 2 study, which in turn relied on the Geochemist's Workbench model.[94]

With every new model and every estimated input, there is a new source of uncertainty. "[A]s models become more complex to treat more physical processes, their performance tends to degrade because they require more input variables, leading to greater data uncertainty."[95]

In a model with so many inputs, it is useful to begin sensitivity analysis early in model development "to identify the relative importance of model parameters."[96] Yet, if Ramboll performed any sensitivity analysis, it is not disclosed in the report. In fact, the report makes no attempt whatever to acknowledge, characterize, or evaluate the uncertainty. It contains not only no sensitivity analysis, but no standard deviations, no confidence intervals, no error bars, no alternative scenarios, no uncertainty analysis, and no peer review.

For these reasons, the Department must assume that the mercury estimates are subject to an extremely high degree of uncertainty. Given that the draft model produces outcomes that would comply with the chronic mercury standard by only the thinnest of margins, the inherent uncertainty compels the conclusion that there is no reasonable assurance of compliance. Donlin has not carried its burden to demonstrate otherwise.

This conclusion assumes that the model is otherwise well designed and based on supportable data. If it is not, then violations are even more likely.

E. The draft mercury model contains critical errors underestimating emissions.

Dr. Glenn Miller—Professor Emeritus at the University of Nevada, Reno with substantial experience in mercury contamination from mining[97]—evaluated the Ramboll draft mercury model and found that its predictions of mercury emissions from the mine are implausibly low. "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."[98] He identifies two significant sources of error in addition to multiple sources of uncertainty.

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[94] *Id.* at 3-12 & n.10.

[95] Exhibit 4 at 22 (EPA Guidance); *see also* Exhibit 5 at 7 (G. Miller, "Review of Draft Report: Donlin Gold Mine Supplemental Mercury Modeling and Mass Balance Analysis by Ramboll U.S. Consulting, Inc." (Mar. 4, 2022)) (Miller 2022) (listing other sources of uncertainty in the draft mercury model).

[96] Exhibit 4 at 22 (EPA Guidance); *see also id.* at 16 ("Sensitivity analysis should be used early and often.").

[97] Exhibit 5 at 1, 10-21 (Miller 2022).

[98] *Id.* at 1.

First, the draft model significantly underestimates mercury emissions from the tailings pond, because it apparently fails to consider the cyanide in the tailings fluid.[99] This is important, because cyanide reacts with mercury, making it highly soluble in water.[100] "[T]he mercury content in tailings water is a function of cyanide content…."[101] If, as appears to be the case, the Ramboll report failed to take the cyanide into account, the estimates of mercury concentrations in the tailings pond "may be off by orders of magnitude."[102] He also compares the proposed Donlin project to the Twin Creek tailings facility, which has measured mercury emissions of 63 kg/year, far greater than the 7.5 kg/year Ramboll predicts for Donlin. Miller concludes, "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."[103] The underestimate of emissions from tailings is critical, because the tailings storage facility is the biggest source of nonthermal mercury emissions from the proposed mine.[104]

Second, the draft model also significantly underestimates mercury emissions from thermal sources at the mine by assuming an implausibly high 99.8% efficiency in capturing mercury.[105] Miller compares the proposed Donlin mine to the Barrick Goldstrike Mine in Nevada, which is the largest producer of byproduct mercury in that state (possibly the nation) and is doing a good job of capturing mercury.[106] While Goldstrike emits 60 pounds (27 kg) of mercury per year from the autoclaved ore based on actual measurements, the Ramboll draft mercury model predicts only 35 pounds (16 kg) from Donlin. Miller concludes that "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."[107] Miller attributes the underestimate in part to the fact that the Ramboll draft model relies on emission factor estimates from the companies making the control equipment rather than on actual emissions from operating mines like Goldstrike.[108] Ramboll also assumes predictable levels of mercury management over time, failing to take into account the high variability of mercury managed each year in the real world. For example, at the Goldstrike Mine, annual mercury management varied by a factor of three over just five years.[109] Miller notes that the Ramboll draft model, if correct, would make Donlin

[99] *Id.* at 1-5.
[100] *Id.* at 2.
[101] *Id.* at 3.
[102] *Id.* at 4.
[103] *Id.*
[104] *Id.* at 2; *see also* Ramboll 2021 at ES-2, Tbl. ES-1 (listing sources of mercury emissions).
[105] Exhibit 5 at 5-7 (Miller 2022).
[106] *Id.* at 5, 6.
[107] *Id.* at 7.
[108] *Id.* at 6, 7.
[109] *Id.* at 6.

the best performing gold mine in North America despite managing and producing more mercury than any gold mine but one. This, he finds, "strains credibility."[110]

Miller concludes, "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."[111] Therefore, it is not possible to find reasonable assurance that the proposed mine will comply with the chronic criterion for mercury. Donlin has failed to carry its burden of demonstrating reasonable assurance of compliance.

Dr. Miller's report is attached to this letter as Exhibit 5. ONC incorporates it by reference and requests that the Department provide a complete response to it as if set out here in its entirety.

F. Donlin must comply with both standards, which is even less likely than complying with either standard separately.

Even if it were possible to show reasonable assurance of compliance with either the temperature standard or the mercury standard, Donlin must demonstrate compliance with both (as well as every other applicable standard), which is even less likely. The applicable rule requires a single finding for all water quality standards.[112] It is roughly like needing to get heads twice in a row in a coin toss. There is a 50% chance of getting heads on either toss, but only a 25% chance of doing so on both tosses. The four equally likely outcomes are HH, HT, TH, and TT. Only the first meets the requirement.

The likelihood of meeting both standards would be low even if the odds of meeting each standard were greater than 50%. Assume, for purposes of argument, that the likelihood of meeting each standard was 70%, which would be highly optimistic based on the draft models' projections and inherent uncertainties. In that scenario, assuming the mine's impacts to temperature and mercury are independent, the odds of meeting both standards would be only 49% (70% x 70% = 49%). Thus, even with unrealistically high expectations for each standard, the odds of complying with both are less than 50% and even farther below "reasonable assurance."

The likelihood of complying with both standards in this scenario would probably be even lower than 49%, because one important input—streamflow—is not independent. It has opposite impacts on mercury and temperature. The temperature standard is most likely to be violated when streamflows are low, while the mercury standard is most likely to be violated

[110] *Id.* at 7.
[111] *Id.* at 8.
[112] 40 C.F.R. § 121.2(a)(3) (2019).

when streamflows are high. Thus, as streamflow conditions favor compliance with one standard, they put the other at greater risk, making it even harder to comply with both.

For these reasons, to find reasonable assurance of compliance with both the mercury and temperature standards would require wildly optimistic projections about compliance with each standard, far beyond what Donlin's draft reports justify. Donlin has failed to carry its burden of demonstrating compliance with all applicable standards.

III. Conclusion.

Donlin's draft models make it clearer than ever that there is no reasonable assurance the mine as proposed will comply with the mercury or temperature standards. Donlin commissioned these reports hurriedly, in response to ONC's appeal to Superior Court. Despite the strong incentive to demonstrate compliance with the applicable standards, the models generate outcomes that would only barely do so. Even on the face of the models, assuming for purposes of argument they were well done, these outcomes are so close to the standard and so high in uncertainty that there is no reasonable assurance of compliance with either standard, never mind both. When the assumptions, biases, omissions, and errors of the models are considered, together with the need to meet both standards at all times, it is even more clear that there is no reasonable assurance of compliance. Donlin has fallen far short of carrying its burden to demonstrate reasonable assurance of compliance with all of Alaska's water quality standards.

For thousands of years, the Yup'ik, Cup'ik, and Athabascan peoples of southwest Alaska have relied on the Kuskokwim River, the Yukon River, and their tributaries for the wealth of fish they sustain, for sustenance and health, for travel and trade, and for a way of life. The proposed mine places all of this at risk. The tribes will have to live with the consequences forever, long after Donlin has left. The Department's decision, in short, will resonate for all time. Donlin's draft reports, far from demonstrating compliance with water quality standards, merely reinforce the conclusion that there is no reasonable assurance of compliance.

For these reasons, the Department should rescind the Certificate of Reasonable Assurance.

Thank you for your careful attention to these comments.

Sincerely,

Thomas S. Waldo
Attorney for Orutsararmiut Native Council

APPENDIX A

The Ramboll draft mercury model includes individual estimates of mercury emissions from each of the following sources:

- Fugitive gaseous emissions from the:
  - tailings pond;
  - tailings beach;
  - ore stockpiles;
  - pit; and
  - waste rock facility.

- Stack emissions from:
  - autoclave 101;
  - autoclave 201;
  - carbon regeneration kiln;
  - electrowinning cells;
  - retort;
  - induction melting furnace;
  - boilers/heaters; and
  - incinerators.

- Fugitive dust emissions from:
  - drilling;
  - blasting;
  - ore loading;
  - ore unloading;
  - waste loading;
  - waste unloading;
  - ore hauling;
  - waste hauling;
  - dozer use;
  - grader use; and
  - water truck use.

- Fugitive dust wind erosion from the:
  - tailings beach;
  - haul roads;
  - access roads;
  - waste rock facility;
  - ore stockpiles;
  - overburden stockpile;
  - crusher circuit;

- ore transfer;
- pebble crusher;
- thermal processes; and
- laboratories.

Source: Ramboll 2021 at 3-12 to 3-21.

TABLE OF EXHIBITS