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"Technical Support for Grassroots Public Interest Groups"

June 28, 2013

Office of Environmental Information
(Mail Code: 28221T)
Docket #EPA-HQ-ORD-2013-0189
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, DC 20460
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Re: Comments on Docket #EPA-HQ-ORD-2013-0189, "An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska (Second External Review Draft)," U.S. Environmental Protection Agency, Washington, DC, 910-R-12-004Ba-c, April 2013

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

The Center for Science in Public Participation provides technical advice to public interest groups, non-governmental organizations, regulatory agencies, mining companies, and indigenous communities on the environmental impacts of mining. CSP2 specializes in hard rock mining, especially with those issues related to water quality impacts and reclamation bonding.

GENERAL COMMENTS

Part of my review of the Second External Review Draft involves comparing the responses in the Draft against the Peer Review Panel criticisms in my area of expertise. I believe EPA has adequately addressed a majority of the criticisms of the Peer Review Panel (for my area of expertise). I have attached a partial summary of these responses in Attachment A.[1] I have also addressed some of the critiques of the Second External Review Draft submitted by Northern Dynasty Minerals in Attachment C.[2]

There are some peer review comments which cannot be addressed by the revised document. For example, a common critique of those critical of the Assessment is that it does not consider a final mine scenario as proposed by the mining proponent, and that EPA has released this Assessment in advance of a formal scientific and regulatory reviews under the National Environmental Policy Act. Even though this has been adequately addressed (see the Executive Summary – Summary of Uncertainties in Mine Design and Operation), it will undoubtedly remain a fundamental criticism by mine proponents.

As discussed in the Second External Review Draft, the Assessment is not a mine-specific analysis, but an effort to assess the potential impacts of mining on a regional basis. The argument for waiting for an actual mine proposal and accompanying Environmental Impact Statement (EIS) has several fundamental flaws.

First, it presupposes that an EIS for a mine will provide a detailed analysis of the potential impacts of this type of mining on the region. An EIS is not designed to provide this level of analysis. An EIS is focused on a site-specific proposal.

[1] Attachment A, EPA Watershed Assessment Second Draft Responses to Selected Peer Review Panel Questions & Critiques
[2] Attachment C, Notes on Northern Dynasty Minerals 2nd Watershed Assessment Comments

Second, throughout the 40+ year history of EIS analyses no mine has gone through that process, and been granted permits to operate, where the EIS/permits predicted that permit limits would not be met, or that damage to non-mine resources off the minesite would occur. Yet history is replete with examples of mines that have experienced significant problems in complying with their permits, and that have not met the predictions for performance that were analyzed in the associated EIS. An EIS must assume that fundamental predictions made for its analysis are correct (e.g. geochemistry and hydrology related to ARD contamination), and that mitigation measures will work as designed (e.g. seepage collection systems). But these EIS-related analyses have too often been proved to be wrong.

The EPA's approach in the Bristol Bay Watershed Assessment has been to analyze the general characteristics of this type of mineral deposit (copper porphyry), and the mining methods associated with the development of these deposits. A site-specific EIS is not designed to provide this type of analysis.

Third, a mine-specific EIS will not provide a detailed analysis of the ultimate buildout of the proposed mine. For example, the mine proposal for Pebble will analyze the initial mine, which will not utilize the total mineral resource even as presently defined.[3] The EIS would include a cursory analysis of what an ultimate mine buildout might be in the cumulative effects analysis. However, this ultimate mine buildout analysis will not be significantly more detailed, or accurate, in its predictions and analysis of the mine proposals than in the Bristol Bay Watershed Assessment.

Many mines undergo multiple changes over their life histories. (Attachment B[4]) Furthermore, an EIS is likely to be less detailed in analyzing and predicting potential long term impacts to non-mining resources in the Bristol Bay region than the ecological risk assessment framework of the Bristol Bay Watershed Assessment.

As a final observation on the Second External Review Draft, Chapter 14, Integrated Risk Characterization, is probably the most concise and important chapter in the Watershed Assessment. If I didn't read anything else (including the Executive Summary), I would want to read this chapter. Is there any way to get this chapter to the reader earlier in the document?

VOLUME I – MAIN REPORT – SECTION-SPECIFIC COMMENTS

Executive Summary – Summary of Uncertainties in Mine Design and Operation

> *"This assessment considers realistic mine scenarios that are based on specific characteristics of the Pebble deposit and plans proposed by Northern Dynasty Minerals and are generally applicable to copper deposits in the Bristol Bay watershed. If the Pebble deposit is mined, actual events will undoubtedly deviate from these scenarios. This is not a source of uncertainty, but rather an inherent aspect of a predictive assessment." (p. ES-27 emphasis added)*

Perhaps I am not interpreting the meaning of this statement correctly, but I would opine that while creating mine scenarios is a source of uncertainty, these mine scenarios do not add significantly more to the uncertainty than a specific mine proposal from a developer, especially when the time frame being analyzed moves beyond the proposed lifetime of the specific mine proposal.

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[3] Preliminary Assessment of the Pebble Project, Southwest Alaska, Ghaffari et al., Wardrop-Northern Dynasty Minerals, February 17, 2011, p. 32, Table 1.6.1

[4] Attachment B, Examples of Expansions at Federal or State-Equivalent National Environmental Policy Act (NEPA) at Hardrock Mines in the United States

CHAPTER 4. TYPE OF DEVELOPMENT

Box 4-1. Reducing Mining's Impacts

Recommendation: You might want to reference the GARD Guide (Global Acid Rock Drainage Guide, International Network for Acid Prevention, http://www.gardguide.com).

The GARD Guide is generally accepted as the state-of-the-art summary of the best practices and technology to address ARD issues, and is designed to be continuously updated to reflect changing practices.

4.2.3.4 Tailings Storage

> *"Full liners beneath TSFs are not always used and may not be practicable for large impoundments; however," (p. 4-17)*

Liners are certainly technically viable for any size tailings impoundment.

Recommendation: Clarify by saying "Full liners ... may not economical ..." or "... economically practicable..."

CHAPTER 5. ENDPOINTS

Figure 5-9. Total sockeye salmon run sizes by (A) region

The color scheme chosen for pie chart A makes it very difficult to differentiate. Any chance you can change the color scheme on this pie chart? Honestly, I can't distinguish Bristol Bay from the Russian drainages.

CHAPTER 6. MINE SCENARIOS

6.1 Basic Elements of the Mine Scenarios

> *"These three mine scenarios represent realistic, plausible descriptions of potential mine development alternatives, consistent with current engineering practice and precedent." (p. 6-1)*

While the Pebble 0.25 mine scenario can be described as a viable mine scenario, it is not a realistic mine scenario for the Pebble mine – it is much too small to justify the infrastructure required for this large, low grade deposit. Even the Pebble 2.5 mine scenario is on the small side for this particular deposit, as evidenced by the designation of the 45-year, 3.8 billion ton scenario, as the "base case" for the Wardrop Study.[5]

However, it is emphasized in the Second External Review Draft that:

> *"The mining of other existing porphyry copper deposits in the region would likely include the same types of mining activities and facilities evaluated in this assessment for the Pebble deposit … would likely be most similar to the smallest of the mine scenarios analyzed in this assessment (Pebble 0.25), because the other ore bodies are believed to be much smaller than the Pebble deposit." (p. ES-4)*

Recommendation: You might clarify that the Pebble 0.25 scenario is likely to be an example of a nearby mine scenario than a plausible scenario for mine development at Pebble.

[5] Ghaffari et al. (2011), p. ES-4

Table 6-3. Summary of water balance flows (million m^3/year) during operations for the three mine scenarios.

"Cooling Tower Losses" are listed as one of the minor sources for water use/loss. I'm not sure if there will be significant cooling tower losses, since the mine plans to use waste heat for low temperature on-site applications.[6]

6.3.2 Tailings Storage Facilities

In this section there is a discussion of the need to monitor some mine facilities, primarily the tailings dams, waste rock piles, and the abandoned open pit and underground mine, in potentially in perpetuity. With regard to the tailings dam and impounded tailings, it is noted:

> *"... we do not assume that tailings consolidate to a fully stable land form. Thus, the system may require continued monitoring to ensure hydraulic and physical integrity in perpetuity." (p. 6-33)*

Recommendation: You could also add that another reason for the need to "maintain" the dam is that even though the tailings themselves may consolidate, they would still be susceptible to erosion if the integrity of the dam were to be compromised.

6.3.5 Premature Closure

> *"The Illinois Creek and Nixon Fork mines are examples of mines that closed prematurely in Alaska (although Nixon Fork has since re-opened)." (p. 6-35)*

Both Illinois Creek and Nixon Fork were each "reopened" after spending several years in temporary closure status. Illinois Creek was closed in 1998 shortly after the mine was opened as the result of the bankruptcy of the Dakota Mining Corporation. The closure bond for the mine was not adequate to complete mine reclamation, and after considerable effort the Alaska Department of Natural Resources was able to contract with a newly formed Alaska corporation, the American Reclamation Group LLC, to 'operate the mine for closure' and reclamation was essentially completed in 2002.

6.4.2.3 Chemical Contaminants – Nitrogen Compounds

> *"We know of no studies of nitrogen deposited at mine sites, and the consequences of a change in nitrogen/phosphorus ratio for salmonids are unknown and but **(sic)** judged to be minimal. Thus, nitrogen deposition is not considered in the assessment." (p. 6-41)*

It has been my experience that nitrates remain significantly elevated for many years after mining ceases, particularly in discharges from waste rock piles,[7] and often above the water quality standard of 10 mg/L.

Also the wording in "Table 6-9 – Stressors considered in the assessment and their relevance to the assessment's primary endpoint (salmonids) and USEPA's regulatory authority"

> *"Nitrogen compounds are released during blasting and would deposit on the landscape."*

This wording in the table suggests that EPA is envisioning a plume of nitrogen in the air that settles over the landscape, but doesn't really show up in water. The primary vector for nitrogen releases will be through groundwater discharge to streams from the waste rock.

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[6] Ghaffari et al. (2011), p. 347

[7] Zortman/Landusky Water Quality Data Base, Montana Department of Environmental Quality, Helena, MT

6.4.2.5 Dust

> *"… we do not judge dust from blasting to be an important contributor to risks to salmonids (although this judgment is highly uncertain), and do not consider it in the assessment." (p. 6-41)*

You might also mention dust from the tailings pond, which is typically an issue, because the tailings ponds often have a significant amount of "beach" near the dam itself, both to enhance dewatering of the tailings and to lessen the amount of seepage under/around the dam. An example of the problems dust from a tailings impoundment can cause can be seen at the Questa mine in New Mexico, where heavy metals in tailings dust contaminated a high school.[8]

CHAPTER 8. WATER COLLECTION, TREATMENT, AND DISCHARGE

Table 8-9. Estimated concentration of contaminants of concern in effluents from the wastewater treatment plant, tailings, non-acid-generating waste rock, and potentially acid generating waste rock. Values are µg/L unless otherwise indicated.

"Mg" is listed as a contaminant in this table. Is this Mg or Mn, which would be a more typical contaminant of concern (and Mn is not listed in the Table)?

Recommendation: I also suggest including Fe (as well as Mn) in the table.

8.2.2.1 Copper – Copper Exposure-Response Uncertainties

> *"… copper concentrations are naturally elevated in the highest reaches of the South Fork Koktuli River so biota in those reaches may be somewhat resistant to copper additions." (p. 8-31)*

Analysis of water quality data collected by CSP2 indicates that the extent of naturally elevated copper concentrations are limited.[9]

In addition, it is also possible that the presence of "resistant" biota might suggest the preferential existence of certain species (or conversely the elimination of non-resistant species), rather than the adaptation of existing species to high levels of contamination.

8.2.5 Uncertainties

> *"The tailings test data do not include pyritic tailings, which are strongly acid-generating. This would tend to underestimate the metal content of tailings leachate, but the effects on leachates from a TSF are likely to be small due to the relatively small proportion of pyritic tailings." (p. 8-58)*

Pyritic tailings would equal 14% of the mass of the ore mass.[10] It could be argued that this is not a "relatively small proportion" of the tailings.

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[8] Public Health Assessment for Molycorp, Inc. Questa, Taos County, New Mexico EPA Facility Id: NMD002899094, Agency for Toxic Substances and Disease Registry, February 28, 2005

[9] Investigations of Surface Water Quality in the Nushagak, Kvichak, and Chulitna Watersheds, Southwest Alaska, 2009-2010, Kendra Zamzow, Center for Science in Public Participation, for The Nature Conservancy, July 2011

[10] Ghaffari et al. (2011), p. 354

CHAPTER 9. TAILINGS DAM FAILURE

9.1.2 Probability of Tailings Dam Failures

> *"Because 90% of tailings dam failures have occurred in active dams (Table 9-1), the probability of a tailings dam failure after TSF closure would be expected to be lower than the historical average for all tailings dams." (p. 9-10)*

It might be noted that many, if not most engineered tailings dams are probably 75 years old or less. Since these dams must function in perpetuity, and we do not have data even closely representative of that length of time, the assumption that the probability of tailings dam failure after closure "would be expected to be lower" might be premature.

Box 9-4. Modeling Hydrologic Characteristics of Tailings Dam Failures

> *"If sufficient freeboard were maintained, it would be possible to capture and retain the expected volume of the PMF in the TSF. However, to examine potential downstream effects in the event of a tailings dam failure, we assume that sufficient freeboard would not exist and overtopping would occur. This may be less likely when the TSF would be actively monitored and maintained, but barring human error in the near term, may be more representative of post-closure conditions in the future." (p. 9-15)*

Most tailings ponds have spillways post-closure, and the Pebble Limited Partnership has hinted this may be a feature of some or all of tailings dams at Pebble. As a result, overtopping of a tailings dam due to a lack of "sufficient freeboard" would not be a possibility.

It is also likely possible to maintain a small lake on top of the closed tailings facility while still having a spillway to deal with a probable maximum flood event. That said, the observation that "Tailings dam failure via overtopping is expected to have similar effects as failures resulting from other causes (e.g., slope failure, earthquakes)" is a legitimate concern because, for example, a post-closure breach of the tailings dam due to a seismic-related failure would release a significant amount of saturated tailings.

9.3.1 Hydrologic Characteristics

> *"This assessment recognizes that a variety of scenarios could occur that would influence tailings and debris transport potential. Included here is only one hydrology failure scenario where impoundment capacity is exceeded, due to either lack of freeboard or bypass infrastructure failure. It should be noted that a scenario involving failure during fair weather could also occur and cause similar down-valley flows." (p. 9-16)*

Recommendation: It might be more appropriate to say "... a failure involving a non-hydrologic event ..." rather than "... a failure during a fair weather ..."

Box 9-6. Background on Relevant Analogous Tailings Spill Sites

> *"**Soda Butte Creek, Montana and Wyoming.** The headwaters of Soda Butte Creek drain the New World mining district in Montana before entering Yellowstone National Park. From 1870 to 1953, porphyry deposits were mined for gold and copper with some arsenic, lead, silver, and zinc." (p. 9-35, emphasis added)*

I am aware of gold mining (not porphyry), lead-zinc mining (not porphyry), and copper mining (not porphyry) in the New World mining district, but no porphyry deposits.

There is some speculation that a porphyry copper deposit may exist at depth in this area, but I am not aware of any reports or data that strongly suggest this.

Recommendation: It might be just as relevant to say "deposits" as opposed to "porphyry deposits".

CHAPTER 10. TRANSPORTATION CORRIDOR

10.3.3.1 Chemical Contaminants in Stormwater Runoff – Exposure

"… the number of spills over the roughly 25-year life Pebble 2.0 scenario would be 3.9—that is, 4 spills from truck accidents would be expected during mine operations. Over the roughly 78-year life of the Pebble 6.5 scenario, 12 spills would be expected." (p. 10-30)

It might be mentioned that there has already been a mine-related truck accident that resulted in a fuel spill (Pile Bay Road Spill of 6Jun09), and fuel reached surface waters.

There are also some statistics available from the Red Dog mine where there is truck travel along a haul road that is roughly half the length (52 miles) to that of the road proposed for Pebble.

"Based on the average daily trips in 17 years more than 200,000 concentrate and 10,000 fuel truck trips have occurred. In that 34 documented spills have resulted in over 1,000 tons of concentrate being spilled. From 2000 through 2007 one fuel truck spill of 7,000 gallons occurred."[11]

The documented spill rate at Red Dog is approximately 2/yr. This rate would yield 156 spills over a 78-year mine life at Pebble (in addition the road at Pebble would twice as long as the road at Red Dog).

CHAPTER 11. PIPELINE FAILURES

11.5.4.2 Risk Characterization – Duration of Risks

"Diesel and natural gas pipelines would be retained after mine closure as long as fuel was needed at the mine site (e.g., for monitoring, water treatment, and site maintenance). Therefore, the diesel pipeline risks would continue for ***(sic)*** *indefinitely." (p. 11-30)*

It is likely that the requirement for diesel after mine closure would decrease to the point where operating/maintaining a pipeline would not be economically viable, and on-site diesel requirements would be met by trucking.

CHAPTER 14. INTEGRATED RISK CHARACTERIZATION

14.1.2.1 Tailings Dam Failure

"Each TSF has multiple dams, but the probability of a spill from a TSF would not increase in proportion to the number of dams for an individual TSF, because failures would not be independent events." (p. 14-7)

Recommendation: Rather than say "... but the probability of a spill from a TSF would not increase in proportion to the number of dams for an individual TSF, because failures would not be independent events," I believe it would be more correct to say "... but since available data on tailings dam failures does not include dam length, the probability of dam failure as related to dam length cannot be made."

[11] Red Dog Mine Extension Aqqaluk Project, Final Supplemental Environmental Impact Statement, Volume 1, Tetra Tech, October, 2009, p. 3-159

Thank you for the opportunity to comment on the Draft Assessment.

Sincerely:

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

ATTACHMENTS

Attachment A: EPA Watershed Assessment Second Draft Responses to Selected Peer Review Panel Questions & Critiques

Attachment B: Examples of Expansions at Federal or State-Equivalent National Environmental Policy Act (NEPA) at Hardrock Mines in the United States

Attachment C: Notes on Northern Dynasty Minerals 2nd Watershed Assessment Comments

Attachment A

EPA Watershed Assessment Second Draft Responses to Selected Peer Review Panel Questions & Critiques

PEER REVIEW COMMENT (David A. Atkins): I would suggest a broader range of potential mining scenarios be organized as follows, with the detail of assessment necessarily becoming more speculative with each subsequent scenario in the list (due to the lack of geologic and engineering information on the other deposits):

- Development of one, average-sized porphyry copper deposit (50th percentile or 250 million tonnes of ore as described in Appendix H) in the location of the Pebble deposit.
- Development of a mega-mine in the location of the Pebble deposit (of the range between 2 and 6.5 billion tonnes of ore) that may develop after multiple expansion and permitting cycles.
- Development of a mining district consisting of an average-sized Pebble mine and other potential mines (i.e., those presented in Chapter 7).
- Maximum development of all identified potential resources to their most likely ultimate extent.

EPA Response: For the assessment, EPA used information on porphyry copper deposits and mining practices to develop three mine size scenarios: Pebble 0.25 with 0.25 billion ton (0.23 billion metric tons) of ore, Pebble 2.0 with 2.0 billion tons (1.8 billion metric tons) of ore, and Pebble 6.5 with 6.5 billion tons (5.9 billion metric tons) of ore. These three mine scenarios represent realistic, plausible descriptions of potential mine development alternatives, consistent with current engineering practice and precedent. The scenarios are not mine plans: they are not based on a specific mine permit application, and are not intended to be the detailed plans by which the components of a mine would be designed. However, the scenarios are based on preliminary mine details put forth in Northern Dynasty Minerals' Preliminary Assessment of the Pebble Mine (Ghaffari et al. 2011), as well as information from scientific and industry literature for mines around the world. Thus, the mine scenarios reflect the general activities and processes typically associated with the kind of large-scale porphyry copper mining development likely to be proposed once a specific mine application is developed. EPA used these scenarios to benchmark potential risks resulting from this type of development, to provide decision makers with a better understanding of potential risks associated with any specific action proposed in the future. (Second External Review Draft, p. 6-1)

PEER REVIEW COMMENT (Gordon H. Reeves): A major component that is missing from the report is consideration of the potential impacts of climate change.

EPA Response: Climate change has been addressed in the Second External Review Draft, section 3.8 Climate Change. See also pp. 10-41, 12-17, 14-14, and Box 14-2. Climate Change and Potential Risks of Large-Scale Mining.

PEER REVIEW COMMENT (Charles Wesley Slaughter): The Assessment does not adequately address the road/stream crossing/culvert issue. Given the projected transportation corridor, Pebble locale to Cook Inlet, and the inevitability of a further network of "minor" roads in the mine and TSF locale, plus additional infrastructure linkages, road/culvert/stream crossings are a major concern for aquatic habitat and fisheries. Readers of the Assessment should be directed to Frissell and Shaftel's Appendix G for a more comprehensive discussion of this important topic.

EPA Response: The Second External Review Draft contains an extensive discussion of culverts in chapters 6 and 10 (also see Box 10-2. Culvert Mitigation). The Second Draft also includes a revised appendix "Foreseeable Environmental Impact of Potential Road and Pipeline Development on Water Quality and Freshwater Fishery Resources of Bristol Bay, Alaska" (Appendix G)

PEER REVIEW COMMENT (Charles Wesley Slaughter): Even though "We do not assess failures of the natural gas or diesel pipelines…," (p. 6-30) those pipelines would be equally susceptible to failure as

the slurry line. Concerns with pipelines crossing streams, watercourses and wetlands are similar to those earlier expressed for the road corridor.

EPA Response: The risks from failure of product concentrate (Figure 11-1), return water (Figure 11-2), and diesel (Figure 11-3) pipelines are considered particularly high; these failure scenarios are evaluated in Chapter 11. Pipeline Failures. Natural gas is lighter than air, so any release due to a natural gas pipeline failure would rise and dissipate. If the gas cloud ignited, most of the heat would travel upward, but the initial blast and subsequent radiation heating could affect the road and nearby environment. During dry periods, a wildfire could result. Such failures were considered to pose relatively low risks to the assessment endpoints and are not evaluated further in this assessment. (Second External Review Draft, p. 11-1)

PEER REVIEW COMMENT (John D. Stednick): A frequent criticism during the public comment session was that mine plans presented in the assessment are not representative of current standards. A compilation of existing world porphyry mine complexes as well as other types of mines specific to Alaska would better inform the reader of mining processes and potential risks.

EPA Response: A review of 14 operating porphyry copper mines in the United States (including all operating U.S. porphyry copper mines but two that have been operating for less than 5 years)is referenced in the report. (Earthworks. 2012. U.S. Copper Porphyry Mines Report: The Track Record of Water Quality Impacts Resulting from Pipeline Spills, Tailings Failures and Water Collection and Treatment Failure. Washington, DC.)

PEER REVIEW COMMENT (John D. Stednick): The Pebble Limited Partnership has a large environmental baseline database (EBD), but does not appear to be cited or used. Justification for the inclusion or exclusion of these data should be made.

EPA Response: Data from the Environmental Baseline Document 2004 through 2008 (EBD) (PLP 2011) was referenced in the Second External Review Draft – see pp. 3-12, 7-12, 8-23, 9-24, 11-7.

PEER REVIEW COMMENT (John D. Stednick): The TSF would be unlined other than on the upstream dam face and there would be no impermeable barrier constructed between tailings and underlying groundwater. Is this correct? I thought I read the whole TSF would be underlain by liner?

EPA Response: At each TSF, a rockfill starter dam would be constructed, with a liner (high-density polyethylene geomembrane on top of a geosynthetic clay liner) extending up the upstream dam face. The TSF would be unlined other than on the upstream dam face, and there would be no impermeable barrier constructed between tailings and underlying groundwater. (Second External Review Draft, p. 6-9)

Chambers Comment: There have been no indications from the mine developers that the tailings impoundments themselves would have liners. (see Preliminary Assessment of the Pebble Project, Southwest Alaska, Ghaffari et al., Wardrop-Northern Dynasty Minerals, February 17, 2011; and, Pebble Project Tailings Impoundments A & G, Knight Piesold Ltd, September 5, 2006)

PEER REVIEW COMMENT (John D. Stednick): Water management. This is confusing. Collect precipitation for processing, yet divert upstream waters around the mine and not use? Where are the leachate recovery wells, and are they just a safeguard?

EPA Response: In the Second External Review Draft EPA has created a new chapter on Water Collection, Treatment, and Discharge (Chapter 8). This chapter begins with a description of the potential sources of contaminants (Section 8.1) and then describes potential routes and magnitudes of exposure to

contaminated water (Section 8.2). It describes the exposure-response relationships used to screen leachate constituents and considers toxicology of the major contaminant of concern, copper, in greater detail (Section 8.3). The chapter ends with a characterization of the potential risks from aqueous effluents (Section 8.4) and discussions of potential additional remediation and uncertainties (Sections 8.5 and 8.6).

PEER REVIEW COMMENT (John D. Stednick): Is there some chance of "block caving" here? Some text clarifying this point here would be appropriate.

EPA Response: Block caving is described in the Second External Review Draft, section 4.2.3.1 Extraction Methods.

Chambers Comment: Block caving is the only underground mining method employed worldwide for mining large low-grade porphyry copper and molybdenum deposits. Approximately half of the Pebble deposit is too deep to mine economically by the open pit method, and the ore in the Pebble East deposit is of higher grade that in the Pebble West deposit, which is amenable to mining by the open pit method.

PEER REVIEW COMMENT (Steve Buckley): The assessment does not describe the cumulative effects of mine development.

EPA Response: The Second External Review Draft contains a discussion of cumulative effects of mine development in Chapter 13. Cumulative Effects of Large-Scale Mining.

PEER REVIEW COMMENT (William A. Stubblefield): It is unclear why EPA undertook this evaluation, given that a more realistic assessment could probably have been conducted once an actual mine was proposed and greater detail about operational parameters available.

EPA Response: Like all risk assessments, this assessment is based on scenarios that define a set of possible future activities. To assess mining-related stressors that could affect ecological resources in the watershed, EPA developed realistic mine scenarios that include a range of mine sizes and operating conditions. These mine scenarios are based on the Pebble deposit because it is the best-characterized mineral resource and the most likely to be developed in the near term. The mine scenarios draw on plans developed for Northern Dynasty Minerals, consultation with experts, and baseline data collected by the Pebble Limited Partnership to characterize the likely mine site, mining activities, and surrounding environment. Details of any future mine plan for the Pebble deposit or for other deposits in the watershed will differ from our mine scenarios. However, EPA scenarios reflect the general characteristics of mineral deposits in the watershed, modern conventional mining technologies and practices, the scale of mining activity required for economic development of the resource, and the necessary development of infrastructure to support large-scale mining. Therefore, the mine scenarios evaluated in the assessment realistically represent the type of development plan that can be anticipated for a porphyry copper deposit in the Bristol Bay watershed. (Second External Review Draft, p. ES-10)

If the Pebble deposit is mined, actual events will undoubtedly deviate from these scenarios. This is not a source of uncertainty, but rather an inherent aspect of a predictive assessment. Even an environmental assessment of a specific plan proposed for permitting by a mining company would be an assessment of a scenario that undoubtedly would differ from the actual development. (Second External Review Draft, p. ES-27)

PEER REVIEW COMMENT (Phyllis K. Weber Scannell): Too much emphasis was placed on effects of catastrophic failures, such as failure of a tailings dam or pipeline, and too little emphasis on the need to identify and control seepage water, run-off from PAG (potentially acid generating) and NAG (not acid generating) waste rock areas, and water treatment.

EPA Response: In the Second External Review Draft, the assessment considers risks from routine operation of a mine designed using modern conventional mitigation practices and technologies and with no significant human or engineering failures. The assessment also considers various failures that have occurred during the operation of other mines and could occur in this case, including failures of a tailings dam, pipelines, a wastewater treatment plant, and culverts. (Second External Review Draft, p. ES-11)

Included are sections on: Tailings Dam Failure, Pipeline Failures, Common Mode Failures, Wastewater Treatment Plant Failure.

PEER REVIEW COMMENT (Dirk van Zyl): "It is also inconceivable to me that the company will not follow "best mining practices" in the design and development of such a mine."

EPA Response: EPA scenarios reflect the general characteristics of mineral deposits in the watershed, modern conventional mining technologies and practices, the scale of mining activity required for economic development of the resource, and the necessary development of infrastructure to support large-scale mining. Therefore, the mine scenarios evaluated in the assessment realistically represent the type of development plan that can be anticipated for a porphyry copper deposit in the Bristol Bay watershed. (Second External Review Draft, p. ES-10)

EPA recognizes that risks could be further reduced by unconventional or even novel mitigation measures, such as dry stack tailings disposal or the use of armored tanks on the trucks carrying process chemicals to the site. These practices may be unconventional because they are expensive, unproven, or impractical. However, these obstacles to implementation might be overcome, as justified by the large mineral resource and the highly valued natural and cultural resources of the Bristol Bay watershed. (Second External Review Draft, p. ES-26)

Chambers Comment: Companies and regulatory agencies typically follow some, but by no means all, "best practices" in designing and regulating a mine.

Examples of "best practices" that will most probably not be applied voluntarily by the mine operator (for economic reasons), or be required by regulatory agencies at Pebble include:

- a liner for the tailings
- co-disposal of waste rock with tailings
- dry tailings on a liner (to maximize seismic stability and minimize leakage to groundwater)
- bridges over all anadromous stream crossings
- use of downstream instead of modified-centerline dam design

Frankly, to claim that best-practice design would always be followed by mine designers, or required by regulators as a part of the permitting process, is not realistic.

PEER REVIEW COMMENT (Dirk van Zyl): If the mining company is still managing the site, then they will have responsibilities under all Federal and State Regulations and the dire picture painted by the EPA Assessment should not come to pass.

EPA Response: Regulations serve to hold an operator accountable for potential future impacts, through establishment of financial assurance requirements and imposition of fines for non-compliance with permit requirements. Financial assurance does not address chemical or tailings spills because of the greater degree of uncertainty related to these accidents. Reclamation and mine closure can be estimated, but the cost of cleaning up a spill is unpredictable. (Second External Review Draft, Box 4-3. Financial Assurance, p. 4-10)

See also Box 13-2. Examples of Mine Characterization Errors

Chambers Comment: As of 2012 Alaska has 10 operating, proposed, or closed large mines (Pebble, Donlin, Fort Knox, Red Dog, Greens Creek, Kensington, Pogo, Nixon Fork, Rock Creek, and Illinois Creek mines). Of these one has closed before reaching actual operating status (Rock Creek), and one went into bankruptcy with inadequate bonding to cover mine closure (Illinois Creek). To put this more simply, 10% of Alaska large mines have gone into bankruptcy with inadequate reclamation & closure bonding. While Alaska bond calculation procedures have been updated, it would be folly to presume that a bankruptcy with accompanying bond deficiencies could never happen again.

PEER REVIEW COMMENT (Dirk van Zyl): In my review, I did not find that any of the references used in the EPA Assessment refer specifically to mine roads such as those considered for the transportation corridor at the Pebble Mine scenario.

EPA Response: In the Second External Review Draft, see Chapter 10. Transportation Corridor, and specifically the discussion of the Pogo mine road on p. 10-30, and pp. 10-35, 36.

PEER REVIEW COMMENT (Dirk van Zyl): The EPA Assessment does not identify the risks, only the likelihood of occurrence and the consequences. Uncertainties are identified and evaluated for the likelihoods of occurrence and in some cases for the consequences. However, because the magnitudes of the risks are not expressed, their uncertainties are also not explicitly expressed. (T*his generic statement is made a number of times in the review by Dr. van Zyl.*)

The biggest uncertainty/variability in the evaluation of a hypothetical project is associated with the potential range of design features, waste management options and operational details that could be included. This was completely overlooked in the analysis by assuming a specific design for the hypothetical mine.

EPA Response: With the help of regional stakeholders, EPA developed a set of conceptual models to show potential associations between salmon populations and the environmental stressors that might reasonably be expected as a result of large-scale mining. Then, following the USEPA's ecological risk assessment framework, EPA analyzed the sources and exposures that could occur and the potential responses to those exposures. Finally, EPA characterized the risks to fish habitats, salmon, and other fish populations; and the implications of those risks to the wildlife and Alaska Native cultures that use them.

This is not an in-depth assessment of a specific mine, but rather an examination of impacts of reasonably foreseeable mining activities in the Bristol Bay region, given the nature of the watershed's mineral deposits and the requirements for successful mine development. (Second External Review Draft, p. ES-4)

PEER REVIEW COMMENT (Dirk van Zyl): I disagree that "concentrate pipeline failures are common at a modern copper mine." It is recommended that such analyses be performed or that the text be edited to indicate this shortcoming.

EPA Response: EPA provides examples of contemporary concentrate pipeline failures in section 11.3.4.1 Concentrate Pipeline Failure Scenarios, and section 11.3.4.2 Analogous Mines. EPA also references a recent study of spills from porphyry copper mines, "U.S. Copper Porphyry Mines Report: The Track Record of Water Quality Impacts Resulting from Pipeline Spills, Tailings Failures and Water Collection and Treatment Failure," Earthworks. 2012, Washington, D.C.

PEER REVIEW COMMENT (Dirk van Zyl): A significant improvement in tailings management is the implementation of an Independent Tailings Dam Review Board (ITRB) for large mining projects (Morgenstern, 2010). ... I expect that a tailings review board will also be used for the Pebble Mine and the

behavior of a tailings management facility designed and operated under these conditions will be more representative of the potential failure likelihoods expected for such a facility.

EPA Response: The State of Alaska regulates its dams, including tailings dams, under Alaska Administrative Code (AAC) Title 11, Chapter 93, Article 3, Dam Safety (11 AAC 93). Each dam is assigned to a class based on the potential hazards of a tailings dam failure (Table 9-2).

Chambers Comment: Unfortunately there is no requirement Alaska Administrative Code (AAC) Title 11, Chapter 93, Article 3, Dam Safety (11 AAC 93) to convene an independent tailings review board, hence no guarantee, that and independent review board will be utilized at Pebble. Alaska has not utilized an Independent Tailings Dam Review Board for a mine in the past.

Alaska code specifies that a qualified engineer is required to assure that a dam is designed, built, and operated with appropriate concerns for safety. A "qualified engineer" is defined in the Alaska dam safety regulations under Title 11, Chapter 93, Section 193, of the Alaska Administrative Code (11 AAC 93.193). To meet the criteria for a qualified engineer, an individual must be a civil engineer currently licensed to practice in Alaska under the State Board of Registration for Architects, Engineers, and Land Surveyors. The regulations also state that the qualified engineer must have at least five years of experience as a licensed or registered professional civil engineer.

Regardless, Pebble is not the only mine that is likely for the Bristol Bay region if the Pebble Mine is constructed and the transportation infrastructure that would facilitate further development is put into place. It is likely these secondary mines would not face the same level of scrutiny that a large mine like Pebble would.

In addition, there are many examples of the dam construction-type changing in later stages of a mining project. This is perfectly illustrated by the Fort Knox Mine in Alaska where the all but the final stage of tailings dam construction was downstream, but the final dam lift is upstream - the type of construction most susceptible to seismic instability.

PEER REVIEW COMMENT (Dirk van Zyl): Cumulative impacts can only be evaluated once further details about other potential mines and their plans are available. At this time, this section can at best be seen as speculation. It is impossible to improve this part of the assessment with the information on mine development currently available; it can only be done when further information is published by the various mining companies.

EPA Response: This assessment has focused on the effects of a large mine at a single deposit on salmon and other resources in the Nushagak and Kvichak River watersheds, including the cumulative effects of multiple stressors associated with that mine. However, multiple mines and associated infrastructure may be developed in these watersheds. Each mine would pose risks similar to those identified in the mine scenarios. (Second External Review Draft, p. ES-25)

It is reasonably foreseeable that infrastructure from large scale mining in the watershed, particularly the transportation corridors could induce further development in the region. Existing communities, the tourism industry, and the recreational housing market could benefit if large-scale mining expanded through the watersheds. Unmanaged access to currently roadless wilderness areas also could expand. The improved access would increase hunting and fishing pressure, as well as competition with existing subsistence users; increase damage from off-road vehicle, boat, and foot traffic to currently inaccessible areas; facilitate poaching, dumping, trespassing, and other illegal activities; and lead to scattered development in the watersheds.

The mines and road systems described herein are not certain, but are part of state planning documents. A large-scale mine could easily be the trigger that starts this pattern of development in motion. Development in the Pacific Northwest has followed this pattern for over 100 years and has led to the near complete loss

of wild salmon. Even in the coastal population centers of Alaska, hatcheries are supplementing the salmon returns. (Second External Review Draft, p. 13-35)

PEER REVIEW COMMENT (Dirk van Zyl): The EPA Assessment neglects the typical outcomes resulting from the permitting and regulatory processes for new mines, where permit stipulations may require specific actions resulting from discussions, public comments and regulatory frameworks.

EPA Response: Any mining company must comply with a number of federal, state, and local laws when developing and operating a mine. Compliance is facilitated through the regulatory permitting process and involves multiple state and federal agencies (see Box 4-2 for additional detail on these regulatory requirements). Regulations also serve to hold an operator accountable for potential future impacts, through establishment of financial assurance requirements and imposition of fines or compliance orders upon non-compliance with permit requirements (Box 4-3). (Second External Review Draft, p. 4-6)

EPA notes that in the past, however, financial assurance often has not been adequate, and taxpayers have been left with substantial cleanup costs (EPA Can Do More to Minimize Hardrock Mine Liabilities. Washington, DC: U.S. Environmental Protection Agency, Office of the Inspector General. EiDMF6-08-0016-7100223. June 11, 1997)

PEER REVIEW COMMENT (Dirk van Zyl): The EPA Assessment does not contain any references to any such materials, which implies to me that the stakeholder process was informal and not robust.

EPA Response: Meaningful engagement with stakeholders was essential during development of the assessment to ensure that the U.S. Environmental Protection Agency (USEPA) heard and understood the full range of perspectives on the draft assessment itself and the potential effects of mining in the region. USEPA used a variety of tools to involve and inform stakeholders prior to and during release of the draft assessment, including a community involvement plan to ensure that a robust outreach effort is in place and a project webpage and listserv to ensure that assessment-related information is shared with the public. (Second External Review Draft, Box 1-1. Stakeholder Involvement in the Assessment, p. 1-6)

Chambers Comment: It is interesting to note that EPA has been criticized for spending funds to bring EPA staff to Alaska to conduct public meetings and to meet with stakeholders. For example, "The EPA spent $169,381 sending sixteen people — at $10,586 per person — to hold a peer review meeting on the environmental assessment to give the public a chance to comment on the mine's draft assessment." http://dailycaller.com/2013/04/09/senate-likely-to-hit-the-epa-nominee-over-expensive-powerplay-with-pebble-mine/#ixzz2Sixz0BG9"

The $170,000 will have been well spent whether it leads to the development of a better mine, or to the avoidance of a mine that could lead to the expenditure of tens or hundreds of millions of dollars of public funds necessary for cleanup costs and fisheries restoration efforts.

PEER REVIEW COMMENT (Dennis D. Dauble): The assessment deemed that it was "not possible" to determine how far the initial slurry deposition would extend (due to a potential tailings dam failure), how far re-suspended sediments would travel, and how long erosion processes would continue. It seems that information from other mine closure sites could be used by assessment authors to infer effect by analogy. The statement alluding to potential sediment run out distance at the bottom of page 4-56 of the main report should be included in the summary of effects. This is an important point.

EPA Response: EPA used the U.S. Army Corps of Engineers Hydrologic Engineering Center's River Analysis System (HEC-RAS) to model hydraulic characteristics of tailings dam failures caused by flooding and subsequent dam overtopping. See Second External Review Draft, section 9.3 Tailings Dam Failure via Flooding and Overtopping, pp. 9-13-23.

Attachment B

Examples of Expansions at Federal or State-Equivalent National Environmental Policy Act (NEPA) at Hardrock Mines in the United States

Name of Mine	State	Commodity/ Operation Type	New Project EIS/EA	Number of Expansions	Years of Expansions
Fort Knox	AK	Gold / Open Pit / Vat & Heap Leach	1994	2	2001, 2007
Greens Creek	AK	Gold, Silver, Lead, Zinc / Underground	1983	3	1988, 1992, 2003, 2012
Kensington	AK	Gold / Underground	1992	2	1997, 2004 (modifications of new project)
Nixon Fork	AK	Gold / Underground	1995	1	2006
Pogo	AK	Gold / Underground	2003	1	2012
Red Dog	AK	Zinc, Lead / Open Pit	1984	1	2009
American Girl	CA	Gold, Silver / Open Pit Heap Leach / Underground Vat Leach	1988	1	1994
Castle Mountain	CA	Gold, Silver / Open Pit Heap & Vat Leach	1990	1	1997
Mesquite	CA	Gold, Silver / Open Pit Heap Leach	1984	2	1987, 2000
Black Pine	ID	Gold, Silver / Open Pit Heap Leach	1988	1	1994
Grouse Creek (Sunbeam)	ID	Gold / Open Pit Vat Leach (Sunbeam); Gold, Silver / Open Pit Heap & Vat Leach	1984	1	1992
Stibnite	ID	Gold, Silver / Open Pit Heap Leach	1981	1	1994
Thompson Creek	ID	Molybdenum / Open Pit	1980	1	1999 (plan of operations changes)
Beal Mountain	MT	Gold, Silver / Open Pit Heap Leach	1988	1	1993
Golden Sunlight	MT	Gold / Open Pit, Underground Vat Leach	1981	2	1990, 1998
Kendall	MT	Gold, Silver / Open Pit Heap Leach	1989	2	1989, 1995
Montana Tunnels	MT	Gold, Silver, Lead, Zinc / Open Pit	1986, 1990	3	1995, 2008
Stillwater	MT	Platinum Group Metals / Underground	1985	2	1992, 1998

Name of Mine	State	Commodity/ Operation Type	New Project EIS/EA	Number of Expansions	Years of Expansions
Zortman and Landusky	MT	Gold, Silver / Open Pit Heap Leach	1979	21 (total)	(see below)
Zortman & Landusky (together)	MT	Gold, Silver / Open Pit Heap Leach		2	1996, 2001
Landusky	MT	Gold, Silver / Open Pit Heap Leach	1979	9	1980, 1982, 1983, 1984, 1985, 1986, 1988, 1990, 1991
Zortman	MT	Gold, Silver / Open Pit Heap Leach	1979	10	1979, 1980, 1980, 1982, 1983, 1984, 1984, 1987, 1987, 1989
Copper Flat	NM	Copper / Open Pit	1992	1	1996
Bald Mountain	NV	Gold, Silver / Open Pit Heap Leach	1986	1	1995
Battle Mountain Complex	NV	Gold, Silver / Open Pit Heap & Vat Leach	1989	2	2001, 2002
Cortez	NV	Gold, Silver / Open Pit, Underground, Heap & Vat Leach	1969	3	1993, 2008
Cortez Pipeline/ South Pipeline	NV	Gold, Silver / Open Pit Heap Leach	1996	1	2004
Dee	NV	Gold, Silver / Open Pit Heap Leach	1984	4	1991, 1993, 1997, 2013
Denton Rawhide	NV	Gold, Silver / Open Pit Heap Leach	1990	1	1996
Griffon	NV	Gold, Silver / Open Pit Heap Leach	1996	1	1998
Jerritt Canyon	NV	Gold, Silver / Open Pit Heap Leach, Underground Vat Leach	1980	1	1994
Leeville	NV	Gold, Silver / Underground ?	1991	2	2002, 2003
Lone Tree	NV	Gold, Silver / Open Pit Heap & Vat Leach	1991	1	1996
Marigold	NV	Gold, Silver / Open Pit Heap & Vat Leach	1988	2	2001, 2003
Robinson (Ruth)	NV	Copper, Gold / Open Pit Heap & Vat Leach	1993	1	1994
Rochester	NV	Gold, Silver / Open Pit Heap Leach	2001	1	2003

Name of Mine	State	Commodity/ Operation Type	New Project EIS/EA	Number of Expansions	Years of Expansions
Round Mountain	NV	Gold, Silver / Open Pit Heap & Vat Leach	1977	2	1987/1992, 1996
Trenton Canyon	NV	Gold, Silver / Open Pit Heap & Vat Leach	1996	1	1998
Gilt Edge	SD	Gold, Silver / Open Pit Heap Leach	1986	1	1997

Attachment C

Notes on Northern Dynasty Minerals

2nd Watershed Assessment Comments

NOTES on NORTHERN DYNASTY MINERALS

2nd WATERSHED ASSESSMENT COMMENTS

David Chambers, Center for Science in Public Participation, June 2013

GENERAL COMMENTS

Here are NDM's primary critiques of the Watershed Assessment:

1. **EPA has invented its own hypothetical mine;**

   This is an ongoing criticism that mine proponents continue to raise. EPA has responded: "*If the Pebble deposit is mined, actual events will undoubtedly deviate from these scenarios. This is not a source of uncertainty, but rather an inherent aspect of a predictive assessment. Even an environmental assessment of a specific plan proposed for permitting by a mining company would be an assessment of a scenario that undoubtedly would differ from the actual development.*" (Second External Review Draft, p. ES-27)

   Prospective mine plans that have been offered by the owners of the Pebble deposit, which is being touted as an 11.9 billion ton mineral resource,[12] have proposed mine developments ranging from 2 billion tons[13] to 6.5 billion tons.[14] Even these mine plans do not propose to develop nearly the full potential of the mineral resource, as is acknowledged by the mine owners.[15] So the mine plan that the Pebble Limited Partnership submits to regulators for NEPA analysis is highly unlikely to be the plan for the mine that will be ultimately reclaimed and closed.

   For examples of the many mines that have had multiple versions of actual mine plans submitted for NEPA review, see Attachment B "Examples of Expansions at Federal or State-Equivalent National Environmental Policy Act (NEPA) at Hardrock Mines in the United States," Chambers, May13.

2. **EPA has continued to ignore modern mine engineering practices and regulatory requirements; including,**

   a. **"Seepage Rates would Never be Permitted"[16]**
      NDM reviewer Geosyntec asserts the EPA's assumption of 50% capture is too low, and is unsubstantiated. Geosyntec goes on to assert that 100% capture is achievable – but does not substantiate its assertion with references – the same thing NDM/Geosyntec is critical of EPA of doing. EPA has used its "professional judgment" in assuming a 50% capture seepage rate, and lacking good data to substantiate something to the contrary, this assumption is reasonable for the purpose of a risk analysis.

      See the comments for B (3) below.

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[12] Preliminary Assessment of the Pebble Project, Southwest Alaska, Ghaffari et al., Wardrop-Northern Dynasty Mines, February 17, 2011, Executive Summary, Section 1.l.2, p. 6.
[13] Ghaffari et al, 2011, Executive Summary, Section 1.l.2, p. 4.
[14] Ghaffari et al, 2011, Executive Summary, Section 1.l.2, p. 5.
[15] "The Pebble deposit is very large, and even the 78-year Resource Case would exploit only 55% of the total resource." Ghaffari et al, 2011, Executive Summary, Section 1.l2.2, p. 83.
[16] Northern Dynasty Minerals Ltd., 2013a, SUMMARY response to US Environmental Protection Agency (EPA) revised draft Bristol Bay Watershed Assessment (BBWA) report – May 2013

a. "Tailings Storage Facility Designed to Fail"[17]

In the Watershed Assessment EPA has been conservative in its assumptions and analysis of potential tailings dam failures. Mine supporters would like to EPA to assume that the failure of the tailings dam at Pebble could not happen. Making such an assumption for a risk assessment would be both naïve and irresponsible, yet this is indeed what EPA's critics are proposing. Mine proponents always assume that failures are due to "old" technologies or to imprudent practices by less responsible developers, but that these mistakes could never occur on their projects.

See the comments for B (2) below.

b. "Water Treatment Plant Designed to Fail"[18]

In the Second External Review Draft, the assessment considers risks from routine operation of a mine designed using modern conventional mitigation practices and technologies and with no significant human or engineering failures. The assessment also considers various failures that have occurred during the operation of other mines and could occur in this case, including failures of a tailings dam, pipelines, a wastewater treatment plant, and culverts. (Second External Review Draft, p. ES-11)

EPA has also noted:

> "*Based on a review of historical and currently operating mines, some failure of water collection and treatment systems would be likely during operation or post-closure periods. A variety of water collection and treatment failures are possible, ranging from operational failures resulting in short-term releases of untreated or partially treated leachates to long-term failures to operate water collection and treatment systems in perpetuity. A reasonable upper bound failure scenario would involve a complete loss of water treatment and release of untreated wastewater.*" (Second External Review Draft, p. ES-15)

It would be negligent for EPA not to assess the potential impacts from a water treatment plant failure as a part of a risk assessment. It is not appropriate to claim that EPA designed the water treatment plant to fail. EPA merely looked at a range of potential water treatment plant failures – an appropriate and necessary set of assumptions for a risk assessment.

c. "Road Culverts Designed to Fail"[19]

EPA addressed culvert failures in the Second External Review Draft thusly:

> "*Extended blockage of fish passage at road crossings is unlikely during operation in our scenarios, which specify daily inspection and maintenance. However, after mine operations cease, the road may be maintained less carefully by the operator or may be transferred to a government entity that likely would not be able to support daily inspection and maintenance. In either case, the proportion of culverts that are impassable would be expected to revert to levels found in published surveys of public roads (range of 30 to 58%, mean of 47%). Of the approximately 46 culverts that would be required, 35 would be on streams that are believed to support salmonids. Hence, over the long term, 10 to 20 streams would be expected to lose*

[17] Northern Dynasty Minerals Ltd., 2013a
[18] Northern Dynasty Minerals Ltd., 2013a
[19] Northern Dynasty Minerals Ltd., 2013a

passage of salmon, rainbow trout, or Dolly Varden for an indefinite period of time, and some proportion of those streams would have degraded downstream habitat resulting from sedimentation from washout of the road." (Second External Review Draft, p. ES-16-17)

EPA did not take a catastrophic approach toward risk analysis in the Second External Review Draft. As can be seen from the quote above EPA attempted to outline a reasonable long term risk scenario. Unlike the permit-related EIS process, where all of the risks are assumed to be mitigated, in the risk assessment EPA looks at what is likely to happen in the long term based on the actual performance of these facilities.

3. EPA has shunned the best available scientific and environmental data at its disposal[20]

It is difficult to see how NDM can assert that EPA has not considered available scientific and environmental data that is publically available. This material is well-referenced in the Watershed Assessment.

NDM is critical of the use of reports from "*Environmental Organizations and paid Anti-Pebble Activists.*" These reports were independently commissioned and produced, and have been peer reviewed – unlike the NDM's expert reports which were commissioned by and paid for by NDM, and which were not peer reviewed.

NDM is also referring to the use of data from the PLP Environmental Baseline Document, to which there are numerous references in the Watershed Assessment Second Draft. It should be noted that NONE of the Pebble Limited Partnership's data has been peer reviewed, and that the data made available to the public and EPA in the PLP Environmental Baseline Document is in a raw, undigitized format with little or no interpretation, so that it is extremely difficult and time consuming to use. In its data release PLP did not publish and data on geochemistry or fisheries, although that data was available. They also released only data collected from 2004 – 2008, and have not made subsequent data available. So, although NDM claims $150 million has been spent on data collection, most of the data and interpretation is not available to EPA or the public, and none of it has been peer reviewed.

See the comments for A (2) below.

4. EPA has created a public and peer review process designed to minimize scientific scrutiny of its work[21]

It is difficult to follow the rationale of this criticism. EPA has presented is second public draft of the document, and has extended the comment period at the request of mine supporters, including the State of Alaska.

It might actually be more appropriate to turn this criticism around, and ask the Pebble Partnership why it purposely chose to release its data in the Environmental Baseline Document in a form that was not easily usable by technical reviewers; why it chose not to include data on geochemistry, potential fault locations for regional earthquakes, and fisheries; and, why it did not include data more recent than

[20] http://www.northerndynastyminerals.com/ndm/BristolBay.asp?ReportID=586793&_Type=Bristol-Bay-Watershed-Assessment&_Title=Northern-Dynasty-calls-EPAs-Bristol-Bay-Watershed-Assessment-process-biased

[21] http://www.northerndynastyminerals.com/ndm/BristolBay.asp?ReportID=586793&_Type=Bristol-Bay-Watershed-Assessment&_Title=Northern-Dynasty-calls-EPAs-Bristol-Bay-Watershed-Assessment-process-biased

2008 in a 2011 release, even though this data was available. PLP has not released any additional data subsequent to the 2004-2008 data released in 2011.

5. **Throughout the 400 square mile area surrounding Pebble, there are tremendous opportunities to undertake fish mitigation projects that would substantially increase the productive capacity of the area for both salmon and resident fish species.**[22]

   Northern Dynasty proposes to compensate and mitigate for lost salmon and fish production from Pebble Mine by "improving" upon Bristol Bay's already productive natural rivers by bulldozing "new" habitat, adding boulders and logs to rivers, and altering water quality to "improve productivity". Such techniques rarely show scientifically defensible increases in salmon production over the long term, require long-term maintenance and monitoring, and if done improperly can adversely affect salmon habitat and salmon production.

DOCUMENT-SPECIFIC COMMENTS

A. Northern Dynasty Letter to Bob Perciasepe, Acting Administrator, USEPA, from Ron Thiessen, Northern Dynasty Minerals, May 30, 2013

(1) "*A review of the revised 2013 Draft BBWA gives NDM no reason to believe their (the panel's) views or those of PLP received any consideration.*" (Letter, p. 4)

When a project proposed by a proponent that stands to gain significantly from the project is criticized by a government report it is understandable that the proponents will feel slighted. However, the assertion the EPA did not give the comments and suggestions of the review panel any consideration has little basis in fact for anyone that has reviewed the Second External Review Draft. The Second External Review Draft addresses the critical comments/suggestions of the Peer Review Panel. For some examples of EPA responses to the Peer Review Panel comments see Attachment A "Examples of Expansions at Federal or State-Equivalent National Environmental Policy Act (NEPA) at Hardrock Mines in the United States," Chambers, May13.

(2) • *a review of four third-party peer review summaries of seven studies submitted by environmental organizations and anti-Pebble activists as commissioned by EPA, which concludes that none of these studies provide a sound scientific basis for the conclusions reached in the 2013 Draft BBWA (Attachment B).* (Letter, p. 6)

The reports referenced in the 2013 Draft BBWA, Attachment B, were not "commissioned" by EPA.

This statement both misrepresents of the intent of the authors of the reports, of whom I am one, and shows bias toward the Pebble project and against EPA and the "*Environmental Organizations and paid Anti-Pebble Activists*".[23] The reports being criticized were independently commissioned and produced, and have been peer reviewed. These peer review comments, some from consultants who work for the mining industry, do level some criticisms, as would be expected in all peer reviews. The goal for most peer reviewers is to make a report better. However, even if a reviewer says that a report is flawed, that does not make it so. Differences of opinion are common in the scientific community, and ultimately the

[22] Northern Dynasty Minerals Ltd., 2013a
[23] http://www.northerndynastyminerals.com/ndm/BristolBay.asp?ReportID=586269 (accessed 5Jun13)

conclusions of a report must be assessed at face value. After all, there are some that think global warming is a hoax, and it was once commonly accepted that the world was flat, but that did not make it so.

It should also be noted that NONE of the Pebble Limited Partnership's (PLP) data has been peer reviewed, and that the data made available to the public and EPA is in a raw, undigitized format with little or no interpretation, so that it is extremely difficult and time consuming to use. In its data release PLP did not publish any data on geochemistry or fisheries, although that data was available. PLP also released only data collected from 2004 – 2008, and has not made subsequent data available. So, although NDM claims $150 million has been spent on data collection,[24] most of the data and interpretation is not available to EPA or the public, and none of it has been peer reviewed.

It is interesting to note that while the "*Environmental Organizations and paid Anti-Pebble Activists*" have nothing to gain financially if the Pebble project is not approved, consultants who are being paid by Northern Dynasty to review the Second External Review Draft are being described as "*NDM's experts and independent consultants*".[25] NDM's experts and independent consultants have an obvious financial relationship with NDM, yet are still professed by NDM to be "*independent*" while outside groups with no potential for financial gain are being depicted as biased. The absurdity of such a position would be humorous if it were not so often successfully employed.

B. "Assessment of USEPA Response to Geosyntec's Comments on the Bristol Bay Watershed Assessment," Geosyntec Consultants, Letter to Thomas C. Collier, Steptoe & Johnson, LLP, Washington, DC, May 22, 2013, (Attachment C to Northern Dynasty Letter to Bob Perciasepe, Acting Administrator, USEPA, from Ron Thiessen, Northern Dynasty Minerals, May 30, 2013)

(1) "In both 2012 and 2013, the authors failed to consider that modern mining practices are designed to ***reduce the probability of failures of these engineered systems*** *to some established standard of safety, and to minimize the consequences of any failure scenario with the use of modern monitoring systems, contingency planning as part of a mining operations plan, and the establishment of response systems and strategies to control quickly any releases of hazardous materials at the mine site. By omitting the application of modern mine operating best practices designed to reduce the probability of failures and to mitigate quickly the consequences of such failures, the BBWA is clearly biased towards influencing decisions on the fate of the project by implicitly assuming "worst case" outcomes for operation of most of the engineered systems at the future mine site are inevitable." (Geosyntec, p. 2,* ***emphasis added****)*

It would be negligent for a risk assessment not to assess the potential impacts from a worst case scenario. Of course, it is the goal of modern mining practices "*to reduce the probability of failures of these engineered systems*", but as is stated the possibility of these failures can only be 'reduced' not 'eliminated'. For risk assessment purposes it would be negligent for EPA not to assume that a failure of mitigation measures might occur.

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[24] "Although EPA's 'hypothetical mine' is sited at the location of the Pebble deposit, BBWA authors continue to refuse to consider the most extensive scientific data set available on the region -- environmental baseline data collected by the Pebble Limited Partnership (the "Pebble Partnership" or "PLP") at a cost of some $150 million." (Northern Dynasty calls EPA's Bristol Bay Watershed Assessment process 'biased and manipulative', http://www.northerndynastyminerals.com/ndm/BristolBay.asp?ReportID=586793&_Type=Bristol-Bay-Watershed-Assessment&_Title=Northern-Dynasty-calls-EPAs-Bristol-Bay-Watershed-Assessment-process-biased) (accessed 5Jun13)

[25] http://www.northerndynastyminerals.com/ndm/BristolBay.asp (accessed 5Jun13)

This statement suggests that modern mining has solved all of the potential worst case problems. This arrogance ignores a well-documented history of unpredicted failures, and also relies on a definition of modern mining that arbitrarily rules out any unpredicted failure at a mine as being old technology.

(2) *"Use of case studies of past failures of engineered systems to predict the probabilities of future failures is inherently flawed, because of different project histories, variability in site characteristics and the evolution and application of improved engineering practices based on "lessons learned." The use of past failures to predict future probabilities of failures is thus inherently biased toward older technical strategies, past maintenance and inspection failures and/or unique failure modes for the individual case studies." (Geosyntec, p. 4)*

Ignoring case studies of past failures would be irresponsible. This assumes that predictions based on present knowledge and existing tools will address all potential major failures. One only has to look at the recent failure to predict the size and extent of the pit wall collapse at Bingham Canyon, which was being monitored with the latest technology, to see the folly in this logic. As Winston Churchill is famously quoted: "Those who fail to learn from history are doomed to repeat it." History is replete with examples of unanticipated failures at mines.

In the Watershed Assessment EPA has been conservative in its assumptions and analysis of potential tailings dam failures. Mine supporters would like to EPA to assume that the failure of tailings dam at Pebble could not happen, as is evidenced by the comment above. Making such an assumption for a risk assessment would be both naïve and irresponsible, yet this is indeed what EPA's critics are proposing. Mine proponents ALWAYS assume that failures will not occur on their projects.

(3) *"The statement that half (50%) of the leachate from waste rock outside of the leachate zone will escape and flow to surface waters is* ***unsubstantiated****.... In tandem with proper management of potentially acid generating (PAG) waste rock to maximize its placement within the drawdown zone, the capture of PAG waste rock leachate can be close to 100%." (Geosyntec, pp. 10-11,* ***emphasis added****)*

Given the criticism that EPA's assumption is "*unsubstantiated,*" it would be interesting to know if Geosyntec's assertion that "*capture of PAG waste rock leachate can be close to 100%.*" can be substantiated, especially for a mine similar to Pebble. Geosyntec provides no reference to substantiate its claim of 'close to 100%' capture.